Retrofitting of Existing Buildings with Steel Joist

JULY 17, 2019

Presented by:

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Polling Question

- New requirement to earn PDH credits
- Two questions will be asked during the duration of today's presentation
- The question will appear within the polling section of your GoToWebinar Control Panel to respond

Disclaimer

The information presented herein is designed to be used by licensed professional engineers and architects who are competent to make a professional assessment of its accuracy, suitability and applicability. The information presented herein has been developed by the Steel Joist Institute and is produced in accordance with recognized engineering principles. The SJI and its committees have made a concerted effort to present accurate, reliable, and useful information on the design of steel joists and Joist Girders. The presentation of the material contained herein is not intended as a representation or warranty on the part of the Steel Joist Institute. Any person making use of this information does so at one's own risk and assumes all liability arising from such use.

Webinar Description

This webinar will have three parts. Firstly we will discuss and show examples of joists needing to be retrofitted. Secondly, we will demonstrate methods to evaluate existing open web steel joists and Joist Girders for revised loading conditions. The last part will demonstrate the methods with examples of how to modify existing open web joists. This webinar parallels the Steel Joist Institute publication, Technical Digest No. 12 “Evaluation and Modification of Open Web Steel Joists and Joist Girders.

Learning Objectives

1. Show an example of joists that can be retrofitted and an example where joists should not be retrofitted.
2. Identify the key characteristics of in place joists.
3. Demonstrate how to determine who the original manufacturer was and whether they can provide any additional documentation.
4. Show you how to verify the original design loads and evaluate the joist for the new loads.
5. Give several methods and practices to modify existing joists to increase the load carrying capacity.
6. Provide details that are commonly used to increase the load carrying capacity of a joist component.

Introduction

- Commercial manufacturing of open web steel joists began in 1923.

- The Steel Joist Institute was formed in 1928.
  - Open web steel joist use has continued to grow.
  - There are millions of open web steel joists in service.

Introduction

Evaluation and Modification of joists are required for many reasons:

- Building renovations
- Addition loads: roof top units, conveyors
- Field deviations – Dimensional changes
- Other changes not contemplated in the original design
- Damage to the joists

Open Web Products are a Great Solution!

Bowstring girders with rod joists

Field Problems

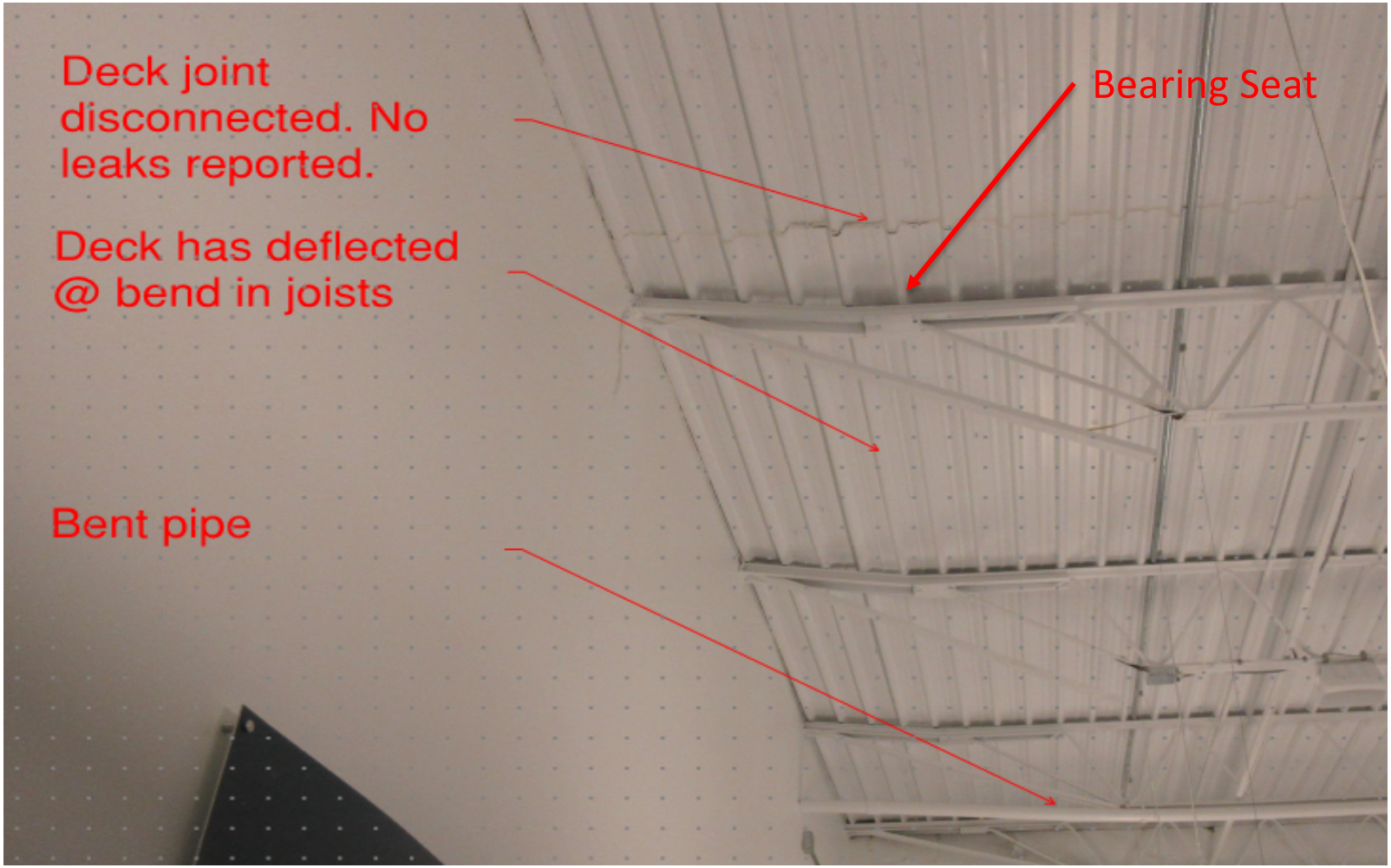
Is anything right?

Steel in a Corrosive Environment

Evaluation? Modification?

Field Problems

Bearing on the end of the top chord extension



Field Problems

Missing end web. Is that web really needed?

Field Problems

Top chord section removed - whoops

Field Problems

Bent bottom chord

Field Problems

Top chord section removed

Field Problems

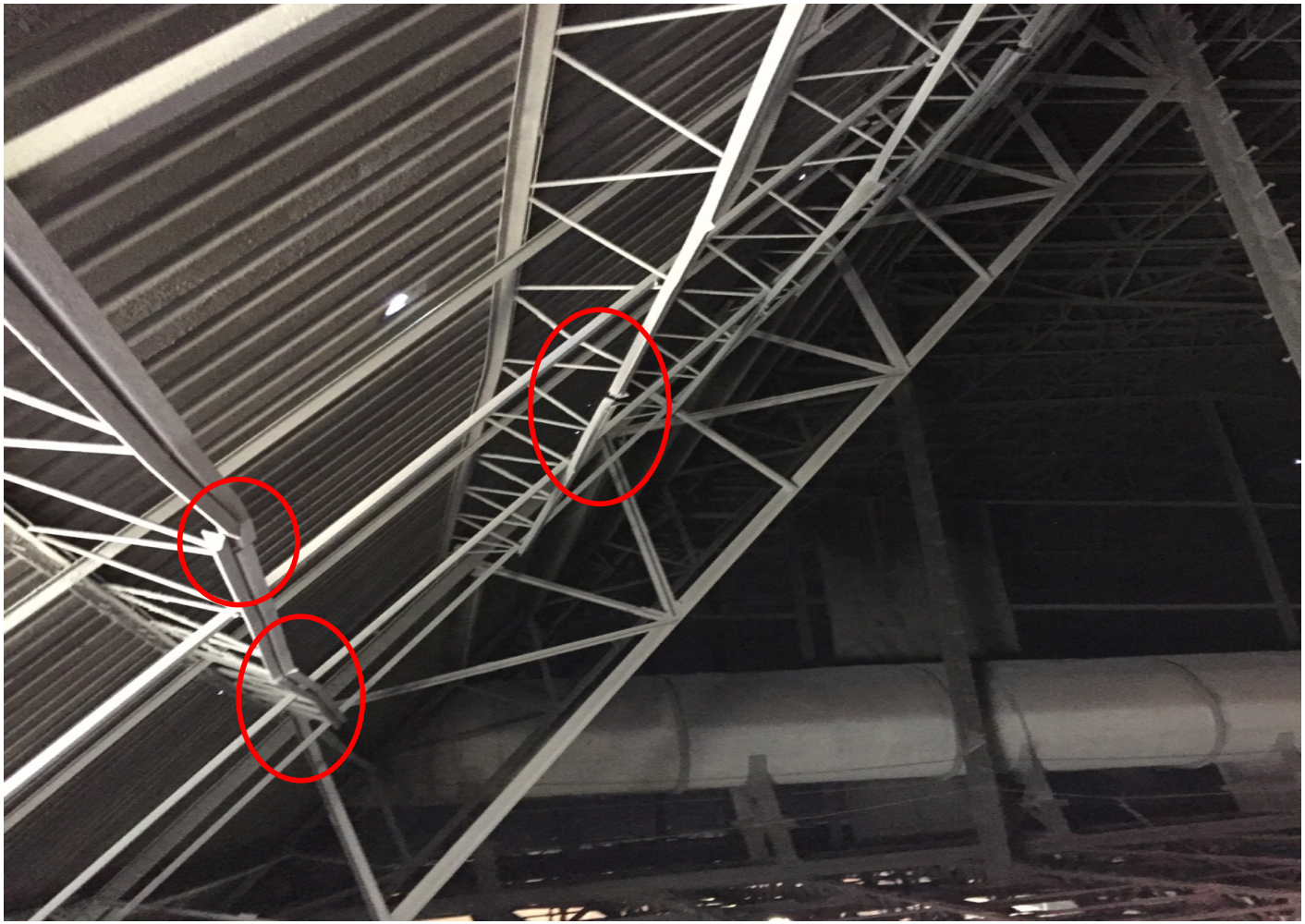
Top chord up?

Field Problems

Fire

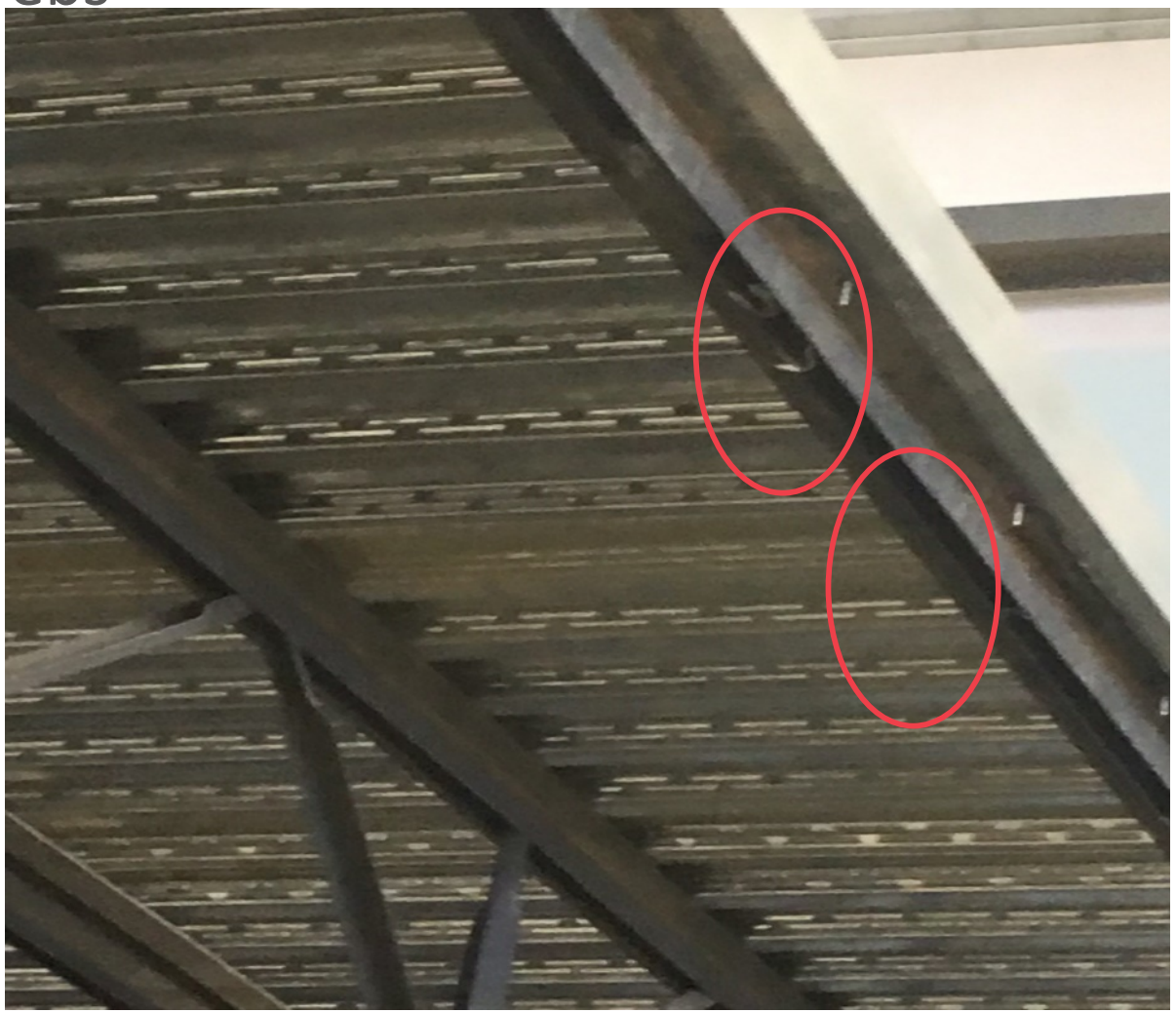
Field Problems

Joist damage



Field Modification and Then an Evaluation

Removed webs



Field Modification and then the Evaluation

Joist Girder too long?

Field Modification and then the Evaluation

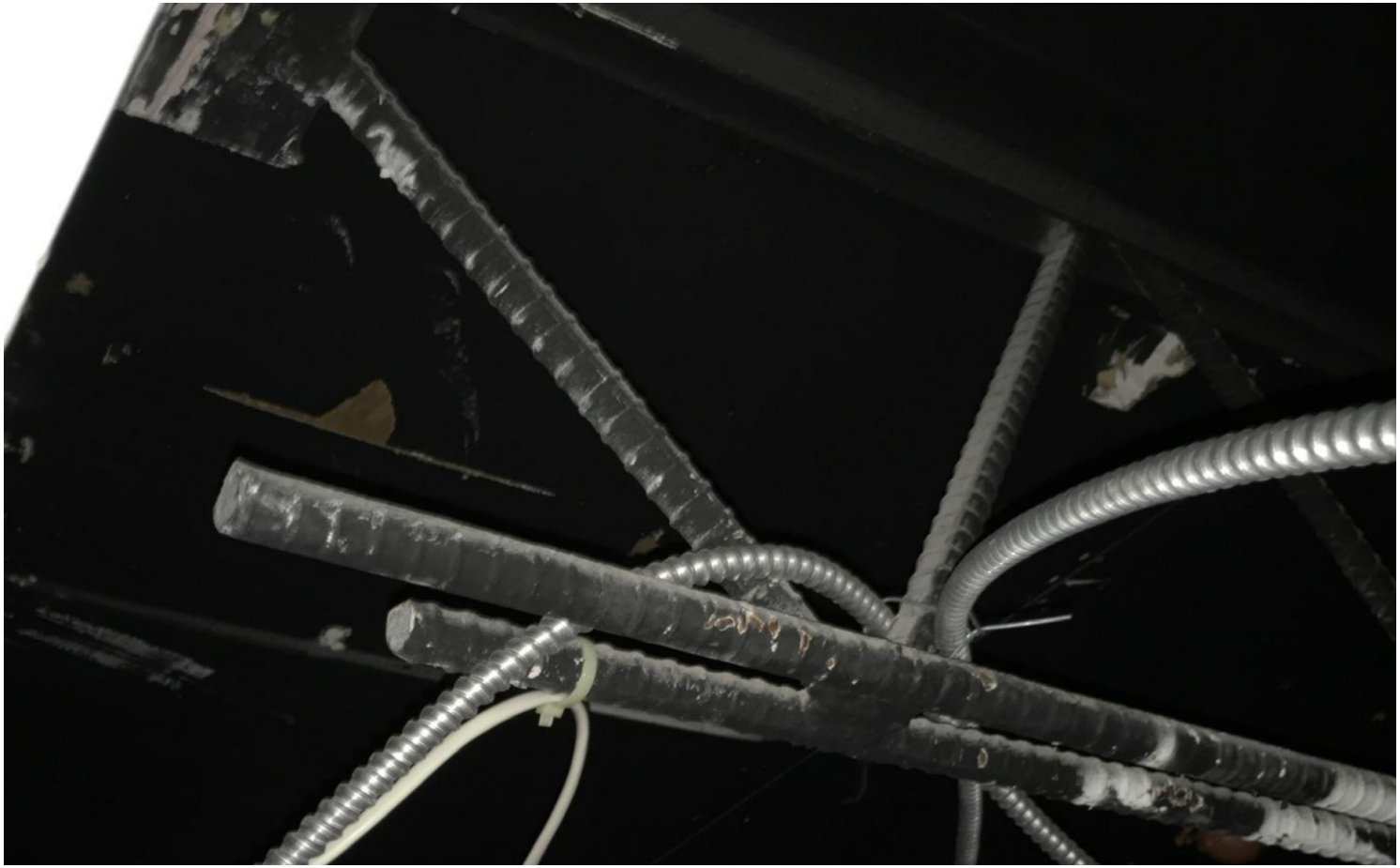
Remove the support wall and damage the joist.

Modification of Joist

Big brace on a little joist

Evaluation

Is this a joist?



Evaluation

What is major damage what is minor damage?

Joist BC Damage During Handling

Chord damage during handling

After Modification then Evaluation Again

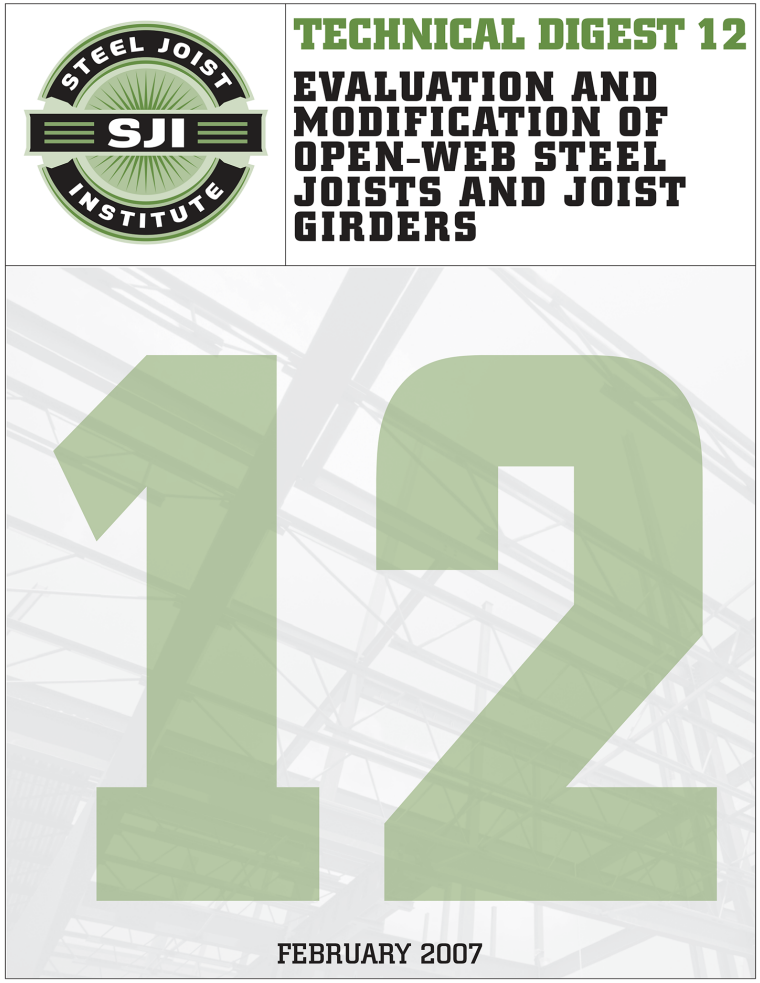
Poor workmanship

SJI Technical Digest No. 12

Evaluation and Modification of Open-Web Steel Joists and Joist Girders

Price: $30

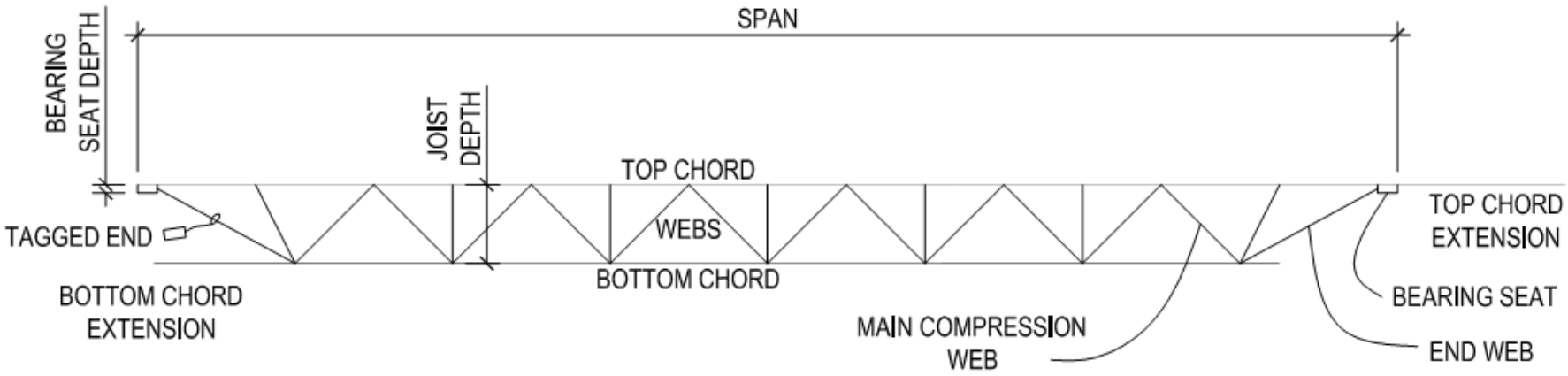
Order from:
www.steeljoist.org



SJI Technical Digest No. 12

Background	
Glossary	
Chapter 1	Evaluations of Existing Joist Strength
Chapter 2	Methods of Supporting Additional Load
Chapter 3	Design Approaches For Strengthening Joists
Chapter 4	Design Approaches For Modifying Joists - Shortening And Lengthening
Chapter 5	Other Considerations
Chapter 6	Summary
References	
Appendix A	Joist Investigation Form
Appendix B	Common Properties of Equal Leg Angles With Leg Sizes 2 In. or Less

Glossary of Terms



Evaluation of Existing Joist

Best case investigation

- Find construction documents
  - Contract drawings and/or joist erection plan
- Onsite investigation
  - Joist metal tag
- Contact joist manufacturer
  - See if calculations are available
- Determine spec under which the existing joist were designed

Evaluation of Existing Joist

Worst case investigation

- Find construction documents
  - No contract drawings and/or joist erection plans available
- Onsite Investigation
  - No joist tag - then documentation of joist is in question
- Complete the Joist Investigation Form
  - Contact SJI for assistance

Joist Investigation Form

Steel Joist Institute assistance

- Appendix A of TD 12
- Fill out the form online
- Download from SJI website
  - **www.steeljoist.org**
- Return to SJI office or manufacturer for assistance

STEEL JOIST INSTITUTE

steeljoist.org

Please complete the following form and email it to sji@steeljoist.org or fax it to 843-407-4044.

Date: _____

Name: _____

Company: _____

Phone: _____ Fax: _____ Cell: _____

Email: _____

Project Details

Jobsite Location City/State: _____

Project Name: _____

Why are you requesting this information? Select all that apply.

☐ Evaluation ☐ Field or erection problem ☐ Inspection ☐ Legal issue
☐ New construction ☐ Rehabilitation or reuse ☐ Seismic retrofit
☐ Structural problem ☐ Other, describe _____

Supplementary Information

What year was the building constructed or approximate age of the structure? _____

Who was the joist manufacturer? _____

Is there a tag on the joist? ☐ No ☐ Yes, provide tag information _____

What type of trusses are the joists? ☐ Warren ☐ Modified Warren ☐ Pratt ☐ Other, describe or sketch _____

What are the joists used for? ☐ Roof loading ☐ Floor loading

234 W. Cheves Street • Florence, SC 29501 • T (843) 407-4091 • F (843) 407-4044

As-Built Design of Joists

How to determine

- Original contract structural documents
- Final joist erection drawings
- Year job was constructed
- Joist manufacturers identification tag
- Field investigation and measurements

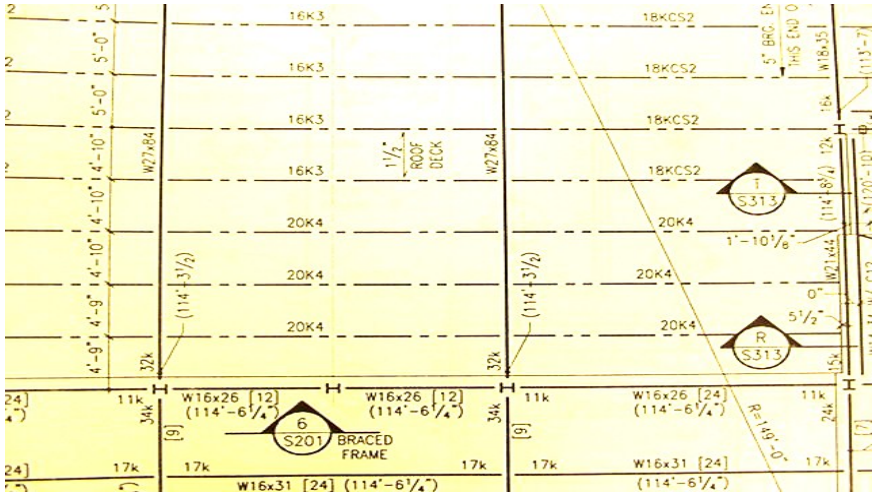
Joist Drawings

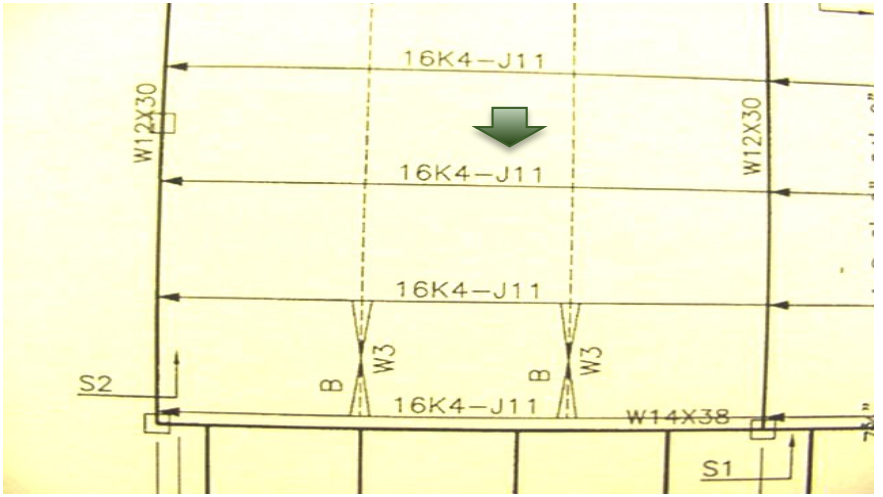
Structural drawing

- Designation
- Joist Spacing

Erection drawing

- Designation
- Joist Spacing
- Mark Number (on metal tag)





Joist Identification Tag

Joist tag information

- Joist manufacturer's name
- Joist manufacturer's job number
- Erection mark number, e.g. J1 or T3

Field Investigation

Helpful and required information

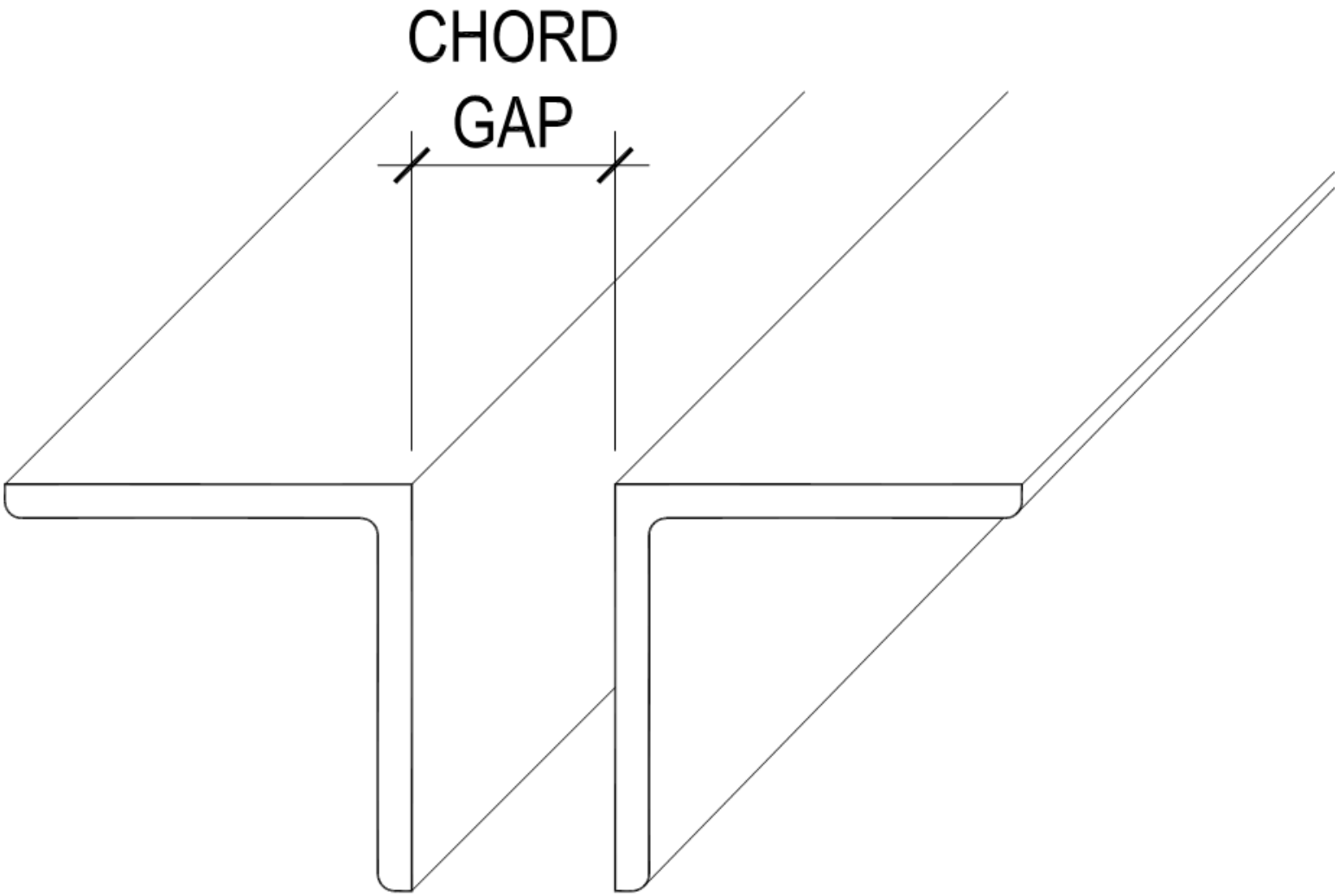
- Loading on the joists
- Information from the joist tags
- Joist configuration
- Joist span
- Joist spacing
- Joist depth or height
- Bearing condition
  - Underslung or bottom bearing
  - Bearing length on structural support

Field Investigation

Type of Chord Members

- Double Angles
  - Separation distance
  - Fillers or ties
  - Ties for double angle webs
- Cold-formed sections
- Rods
- Splices

Type of Chord Members



Field Investigation

Type of web members

- Rod webs
- Crimped angle webs
- Angles welded to the outside of chords
- Cold-formed sections

Type of Web Members

Rod webs

Type of Web Members

Crimped angle webs

Type of Web Members

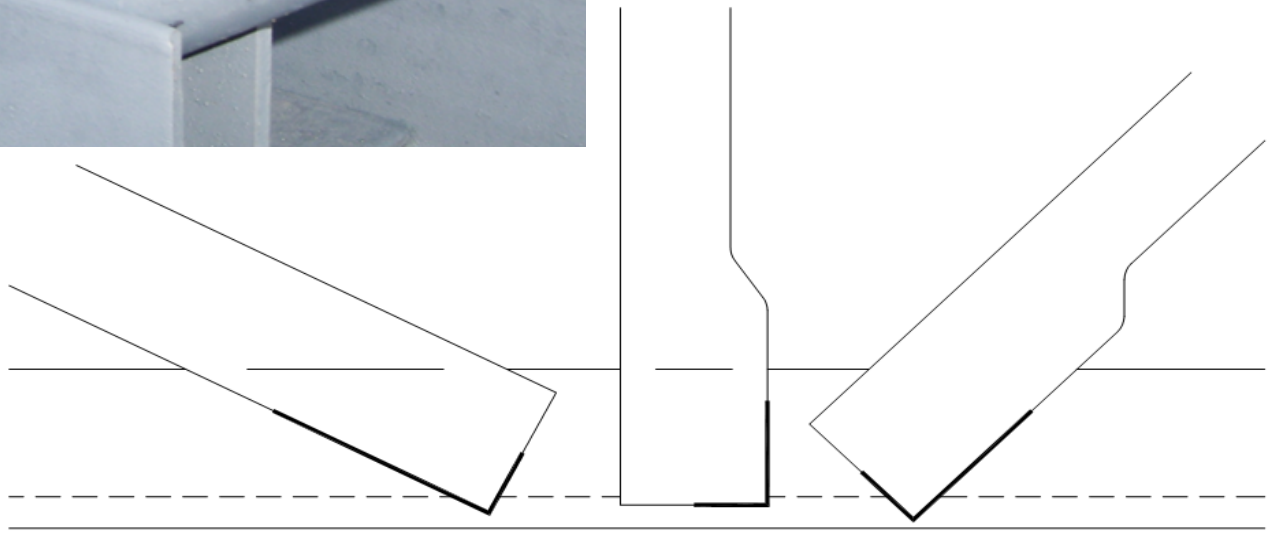
Angles welded to the outside of chords

Field Investigation

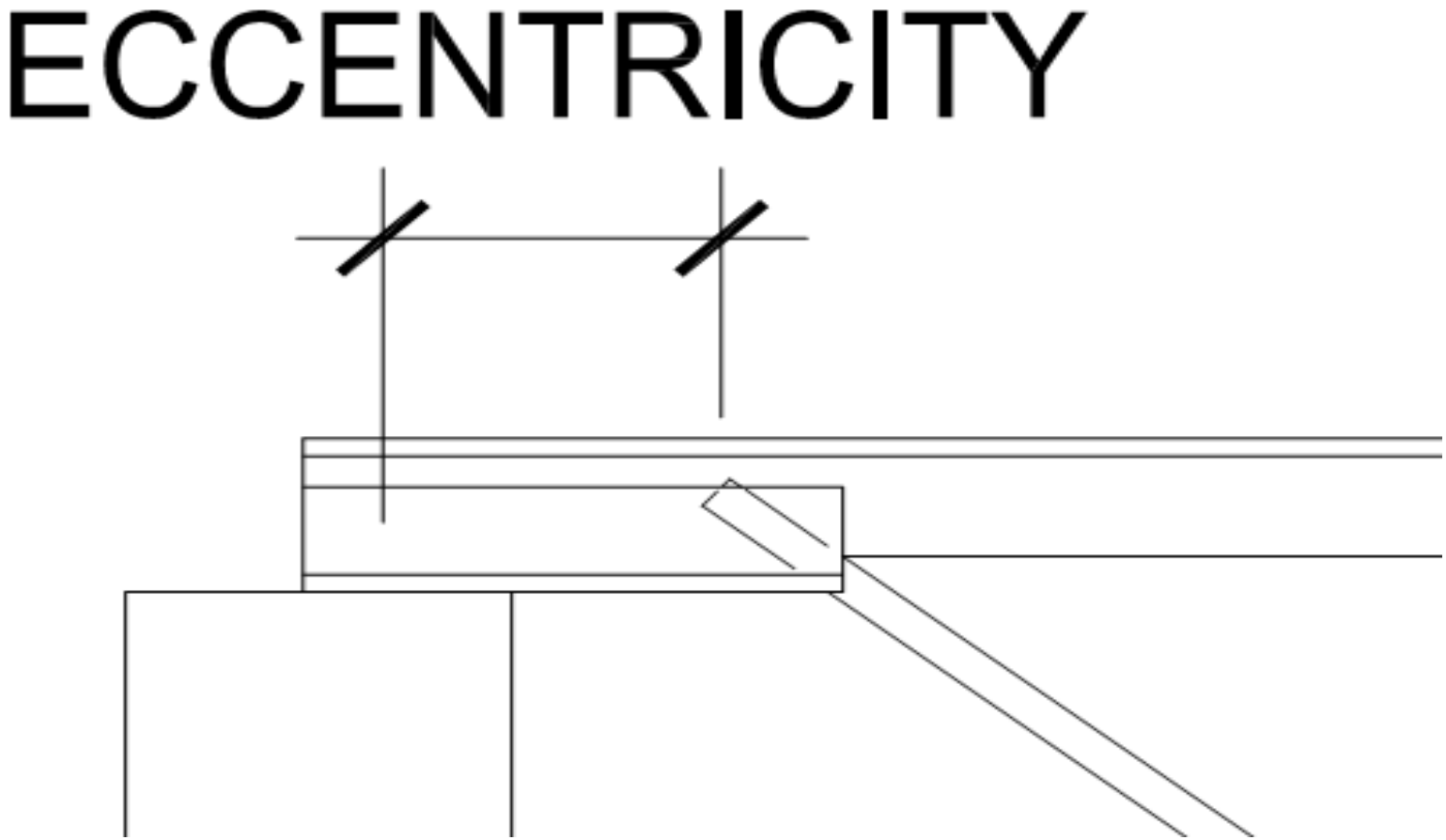
Also take note of:

- End diagonal type
- Eccentricities
- Weld sizes and lengths - welded connections are sized for the design requirements not the overall strength of the member
- Panel point spacing

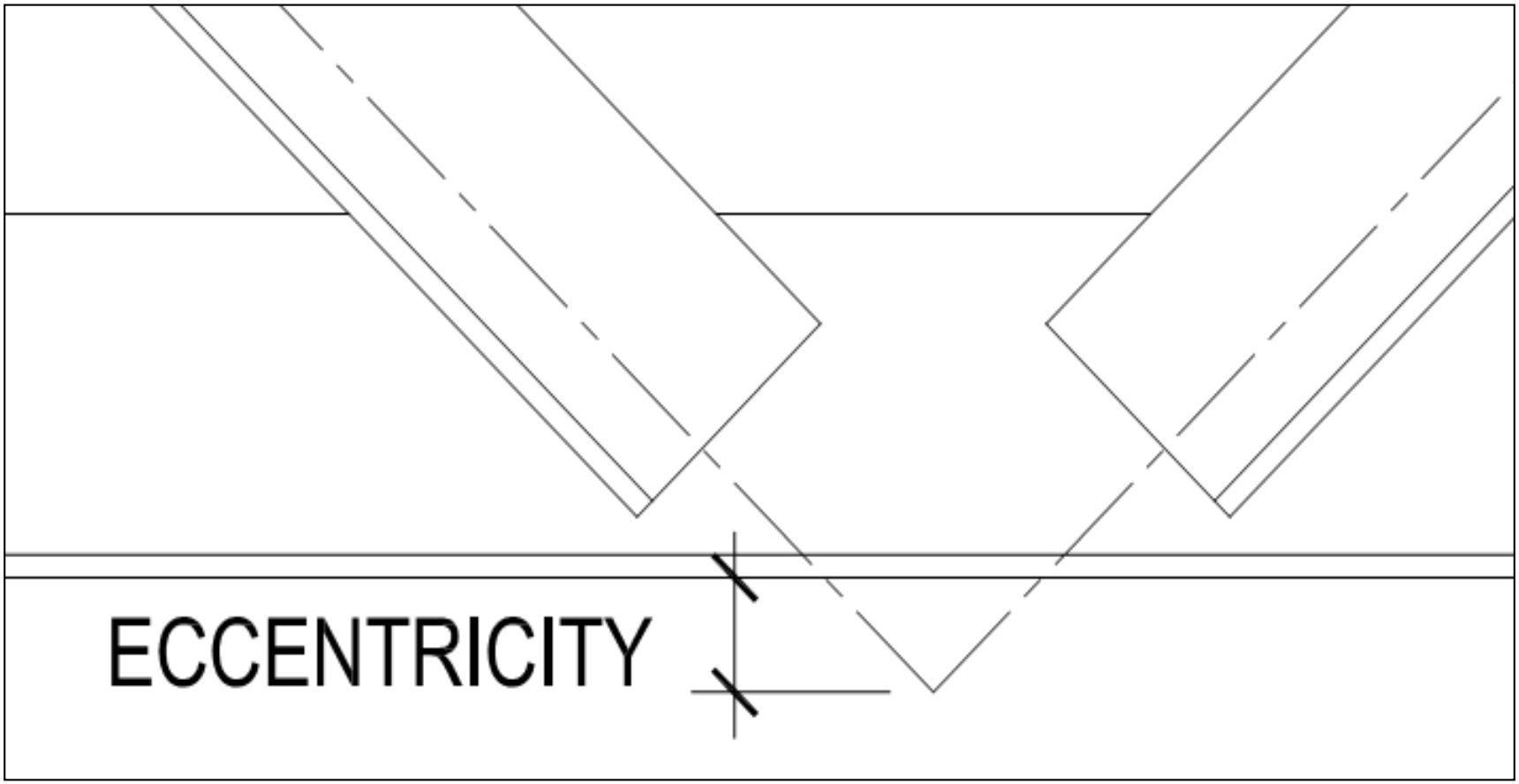
Weld Location



Bearing Eccentricity



Web Eccentricity



Welded Connections

Weld Sizes and Lengths are designed for the original design requirement, not the overall strength of the member.

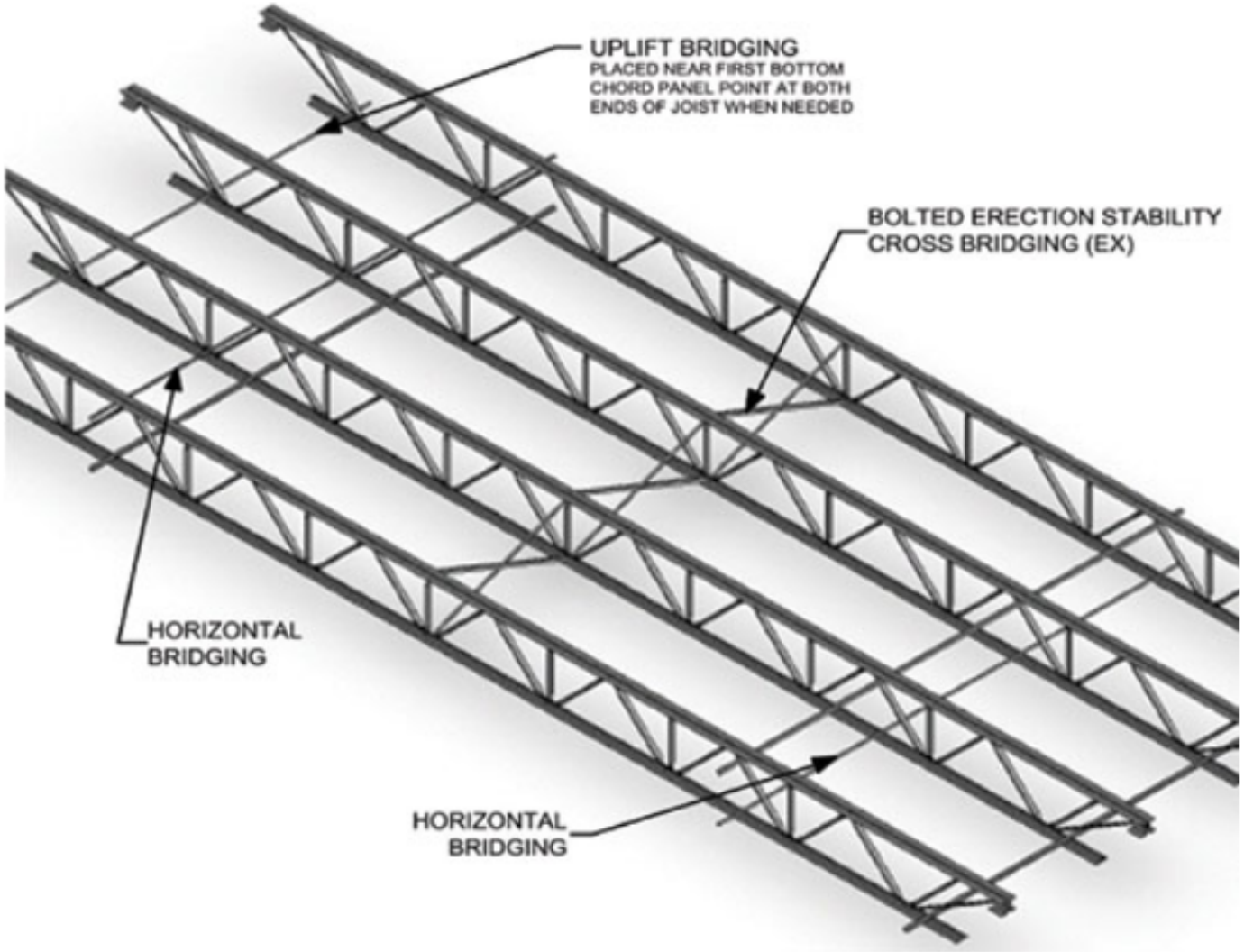
Current SJI specifications require web connections be designed for 50% of the member capacity. Prior to 2015 SJI spec this was not required.

Field Investigation

Other items to note:

- Type of bridging and locations
- Quality of bridging connections
- Anchorage of bridging
- Interferences
- Condition of joists and existing deck
- Coupon samples to determine yield strength

Types of Bridging



85 Year Steel Joist Manual

- Specifications from 1928 to 2002

- Load Tables from 1928 to 2002

85 Year Steel Joist Manual Introduction

INVESTIGATION OF STEEL JOISTS IN EXISTING BUILDINGS

I. General

First and foremost, the investigating engineer, in performing his tasks, should continually be aware of one principal consideration: *the determinations he makes affect the safety of the human beings who occupy the buildings he is investigating.*

Secondly, the task of investigating steel joists in existing buildings is difficult, at best. Personal time, effort, and patience are all required to conduct a proper study.

Thirdly, the investigating engineer should scrupulously observe the following rules:

1) Make as few *assumptions* as possible.
2) Verify by *actual observation and physical measurements* all data whenever possible.
3) Consciously look for *unusual and/or dangerous job site conditions* not specified, shown, or recorded in any documentation.
4) Double check all data.

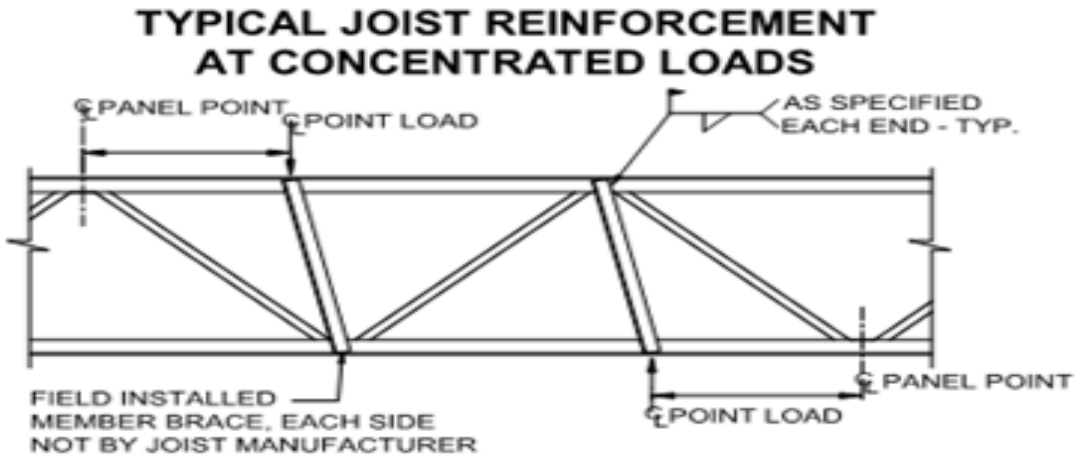
OSHA Federal Regulation
29 CFR 1926.757 (a)(7)

No modification that affects the strength of a steel joist or steel joist girder shall be made without the approval of the project structural engineer of record.

Design Methods to Reduce the Need for Minor Repairs

- 100 pound rule
- Add-loads
- Bend-check
- KCS joists

100 Pound Rule
Page 15, 43rd Edition of the SJI Spec

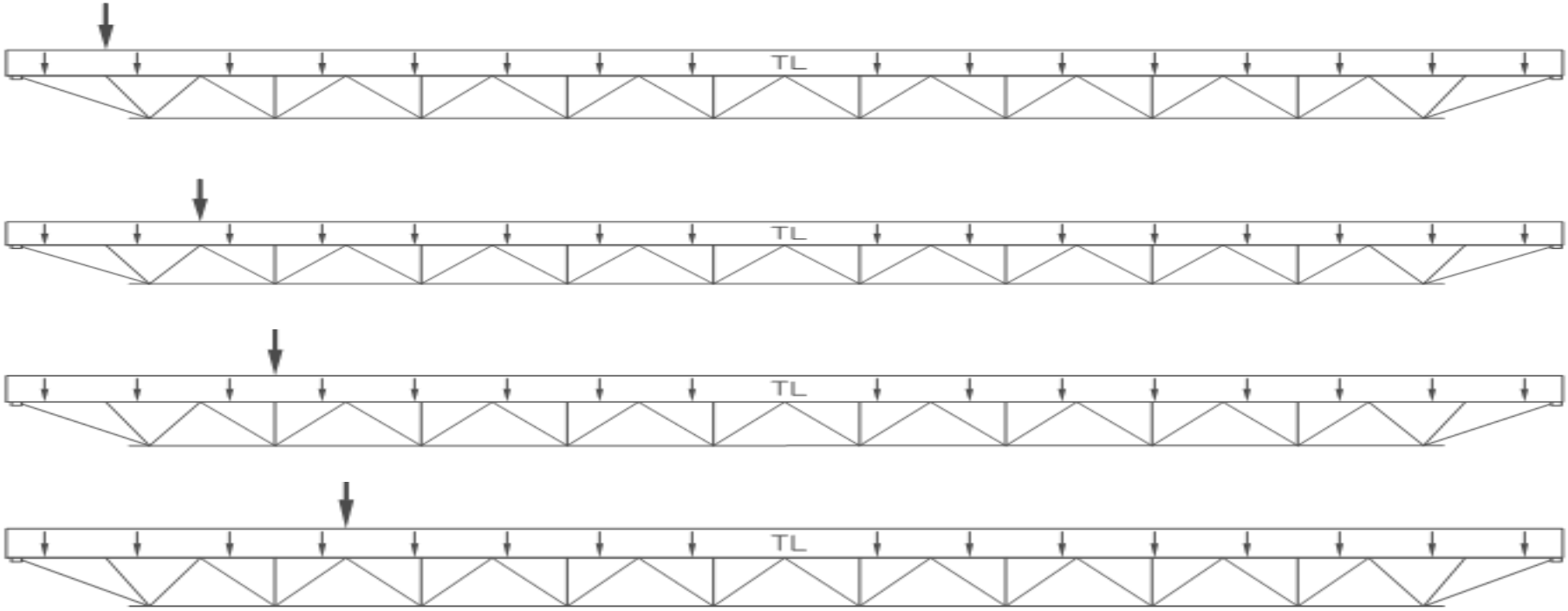


Although standard K-Series, including KCS-Series, and standard LH-Series joists are designed specifically to support uniformly distributed loads applied to the top chord, research conducted by the Steel Joist Institute, using second-order inelastic analysis, has demonstrated that the localized accumulation of uniform design loads of up to 100 pounds within any top or bottom chord panel has a negligible effect on the overall performance of the joist, provided that the load is applied to both chord angles in a manner which does not induce torsion on the chords.

→ Concentrated loads in excess of 100 pounds or which do not meet the criteria outlined above, must be applied at joist panel points, or field strut members must be utilized as shown in the detail above.

Add-Load

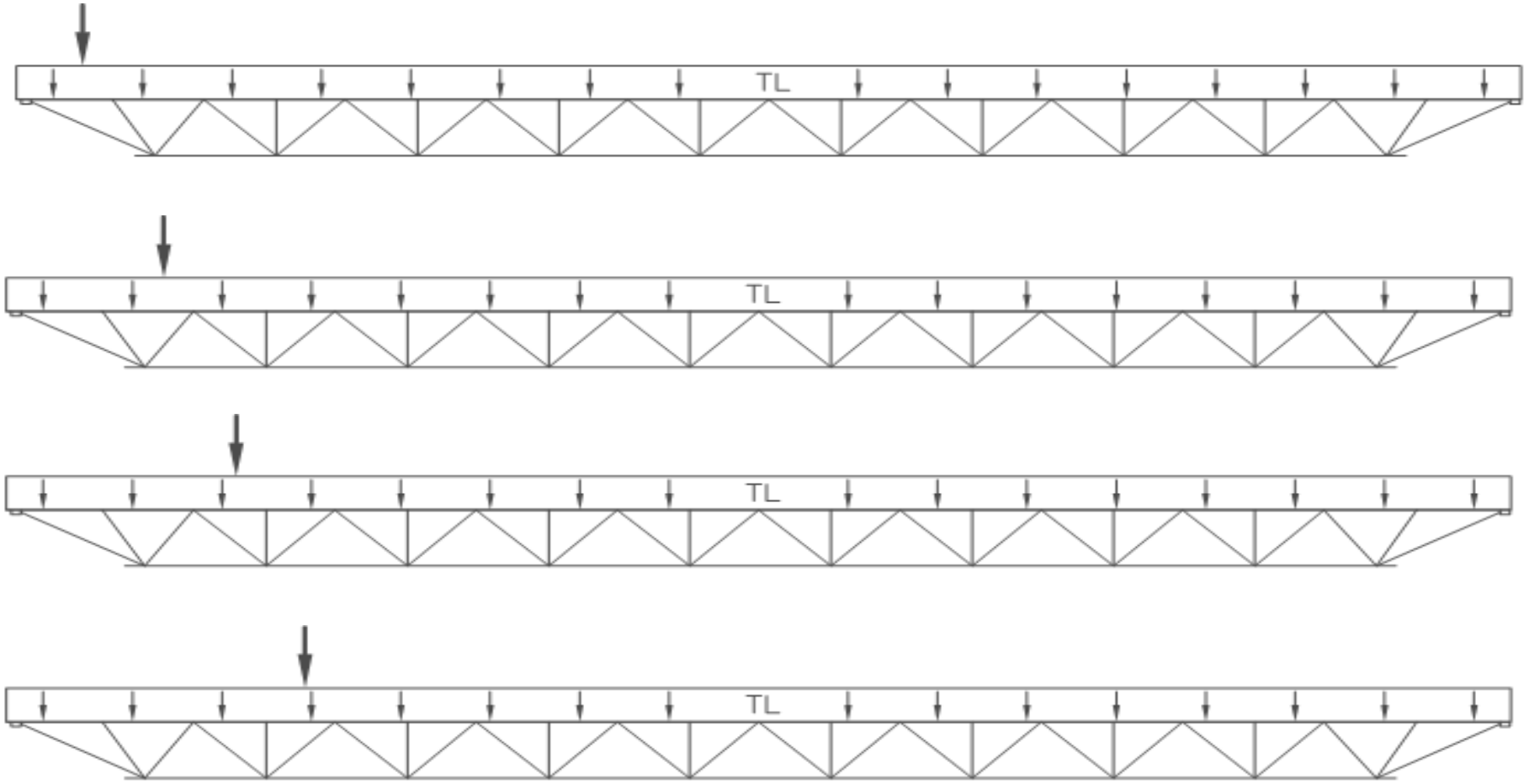
A single vertical concentrated load which occurs at any one panel point along the joist chord. This load is in addition to any other gravity loads.



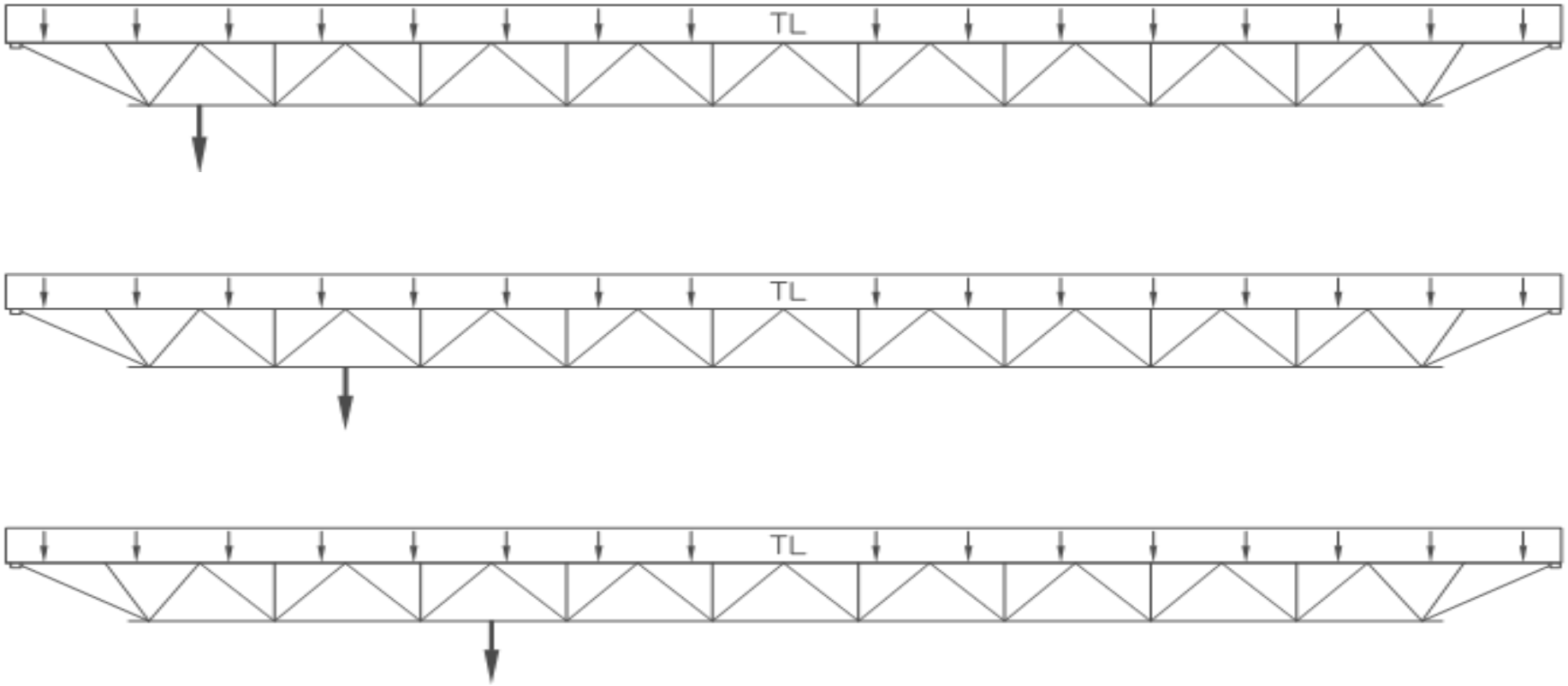
Bend-Check

A vertical concentrated load used to design the joist top or bottom chord for the additional bending stresses resulting from this load being applied at any location between the joist panel points. This load shall be accounted for in the specified joist designation, uniform load or Add-load. It is used only for the additional bending check in the chord and does not contribute to the joist chord axial forces.

Top Chord Bend-Check



Bottom Chord Bend-Check



Specifying the Loads
Page 182, 43rd Edition of the SJI Spec

Option 3: For additional point loads with exact locations not known along the joist or for incidental loads, any one, or both, of the following can be specified on the structural plan in addition to option 1 or 2 above:

a) "**Design for a (__) lb. concentrated load located at any one panel point along the joist**". This is referred to as an "Add-Load".

b) "**Design for additional bending stresses resulting from a (__) lb. concentrated load located at any location along (____) chord**". This is referred to as a "Bend-Check" and can be specified on **top** chord, **bottom** chord, or **both top and bottom** chords. This can be used when the concentrated load is already accounted for in the joist designation, uniform load, or specified Add-Load yet this specified amount of load shall be permitted to also be located at any location between panel points. The additional bending stresses as a result of this load are then designed for. A Bend-Check load shall not exceed (Add-Load + 400 lbs.) A Bend-Check load can be specified by itself without an Add-Load.

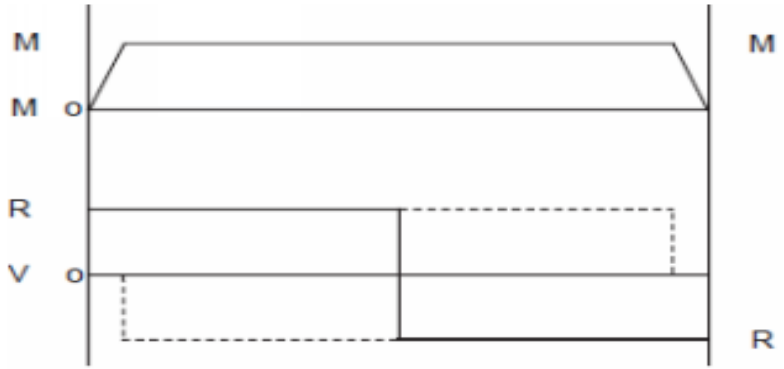
c) Both (a) and (b) above can be specified with equal concentrated loads for each; or simply denote **"Design joist for a (__) lb. concentrated load at any location along the (___) chord."**

KCS Joists

KCS- Series joist advantages:

1. Provides a versatile **K-**Series Joist that can be easily specified to support uniform and non-uniform loads plus concentrated loads applied at panel points.
2. Eliminate many repetitive load diagrams required on contract documents and allow some flexibility of load locations.

KCS-Series joist chords are designed for a flat positive moment envelope. The moment capacity is constant at all interior panels.
All webs are designed for a vertical shear equal to the specified shear capacity and interior webs will be designed for 100% stress reversal.



KCS JOIST
SHEAR AND MOMENT ENVELOPES

Both LRFD and ASD **KCS**-Series joist load tables list the shear and moment capacity of each joist. The selection of a **KCS**-Series Joist requires the specifying professional to calculate the maximum moment and shear imposed and select the appropriate **KCS**- Series Joist.

Polling Question

What is included on the joist tag?

A. Manufacturer name

B. Job number

C. Mark number

D. Joist designation

Chapter 1
Evaluation of Existing Joist Strength

Determine Capacity of Existing Joist System

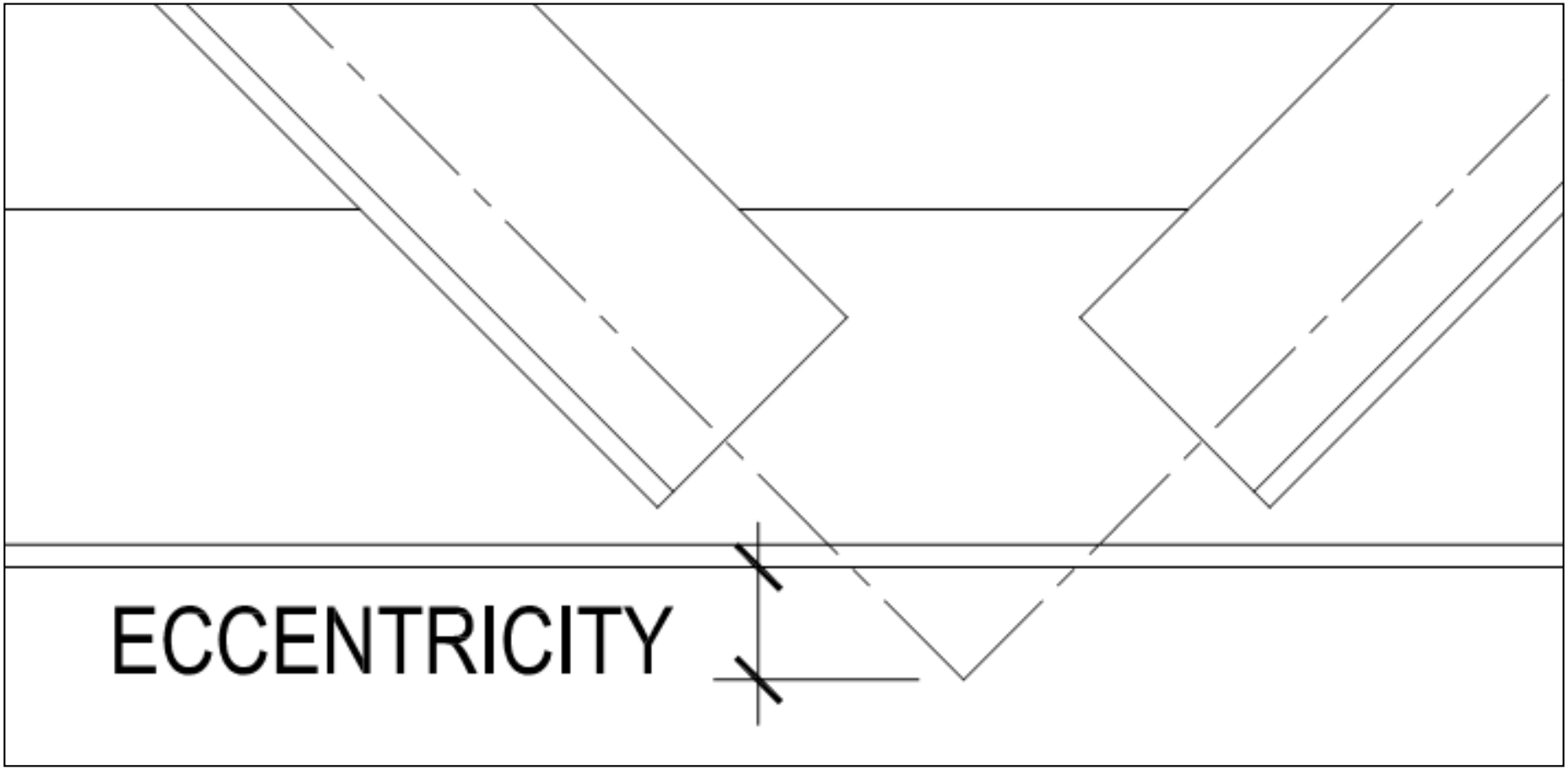
- As-built design of joists
- Existing joists possibly over specified
- Building usage may have changed
- Have joists been damaged

Analysis Considerations

To Analyze Joist Capacity

- Pinned connections are assumed for web members
- Prior to 2015, SJI Specifications for K-Series joists permitted bending to be neglected for uniformly loaded joists when the panel point spacing does not exceed 24 inches
- A first-order analysis is used
- The SJI permits eccentricities to be neglected:
  - For K-Series, the “3/4 Rule” is followed - Spec 4.5 (c)
  - For all other joist series, when the eccentricity “…does not exceed the distance between the centroid and back of the chord”

Web Eccentricity



Actual Member Load Carrying Capacity

- Evaluate the actual member to determine the actual member capacity.
- Evaluate any conservative design assumptions to see if a more accurate condition occurs.
- Evaluate the length and placement of weld.
- Determine the risk of repair verses the in place capacity.
- Use Engineering Judgment.

Example 1.1 Determine if a Joist Requires Reinforcement

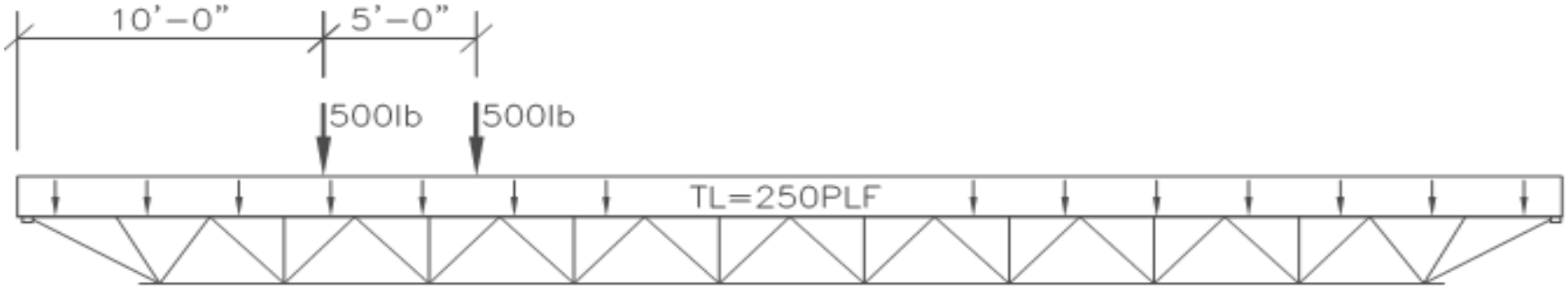
Scenario

- A roof top unit is to be added to two 24K7 joists spanning 40 feet
- Unit adds two, 500 lb. point loads to each joist
  - Located 10 ft. and 15 ft. from one end
- It has been determined that the uniform load on the joist is 250 PLF

Determine if the joist must be reinforced

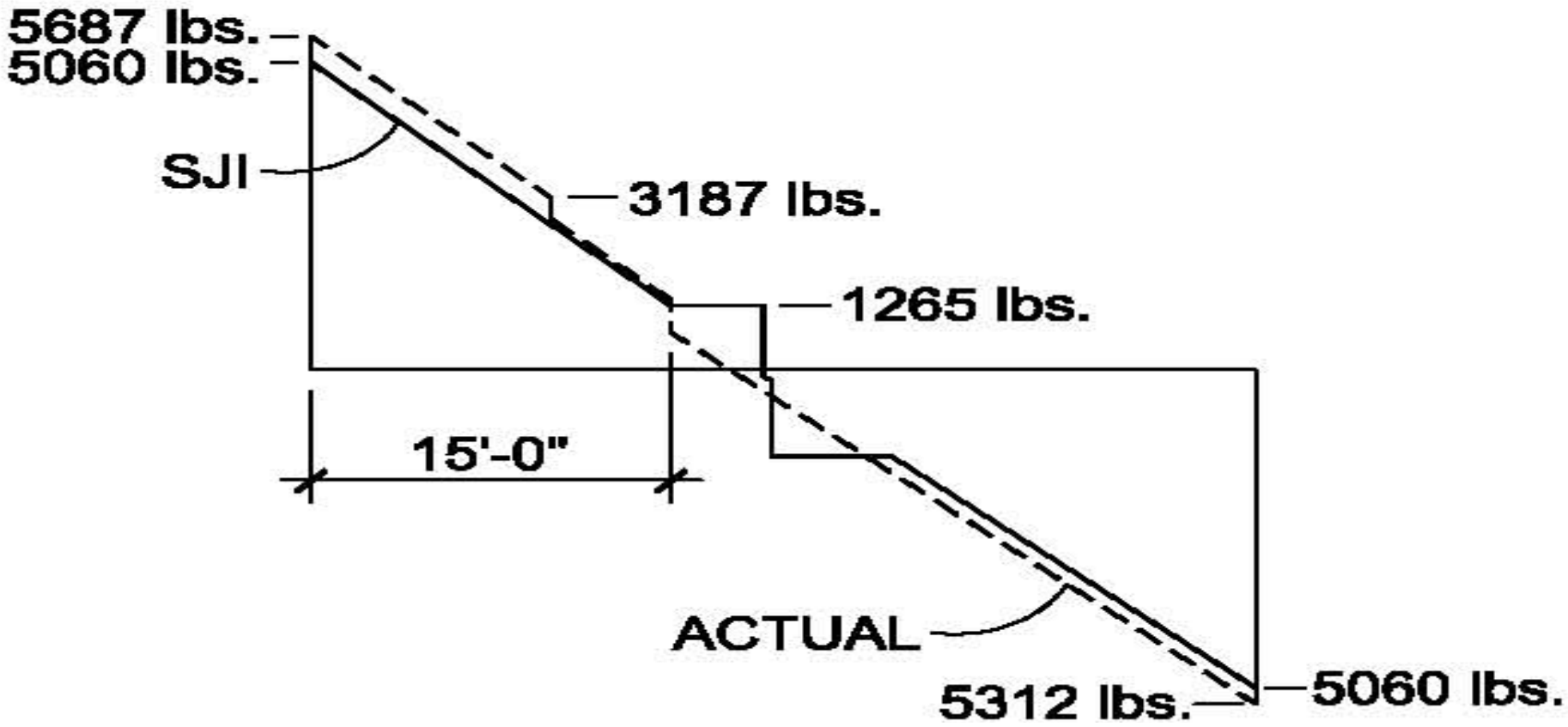
Load Diagram

ORIGINAL DESIGN LOADS



ACTUAL LOADS

Example 1.1
Shear Envelope for 24K7 Joist



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To Analyze Joist Capacity

- Pinned connections are assumed for web members
- Prior to 2015, SJI Specifications for K-Series joists permitted bending to be neglected for uniformly loaded joists when the panel point spacing does not exceed 24 inches
- A first-order analysis is used
- The SJI (Spec 4.5.4) permits eccentricities to be neglected when the eccentricity does not exceed:

  a) the lesser of ¾ of the over-all chord dimension or 2” for single component web members, or

  b) 1½ x the distance to the neutral axis from outside the chord.

Actual Member Load Carrying Capacity

- Evaluate the actual member to determine the actual member capacity.
- Evaluate any conservative design assumptions to see if a more accurate condition occurs.
- Evaluate the length and placement of weld.
- Determine the risk of repair verses the in place capacity.
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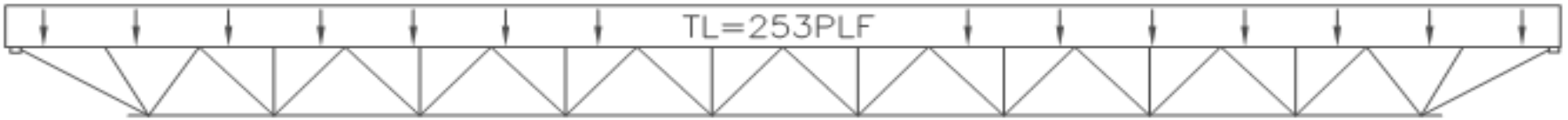
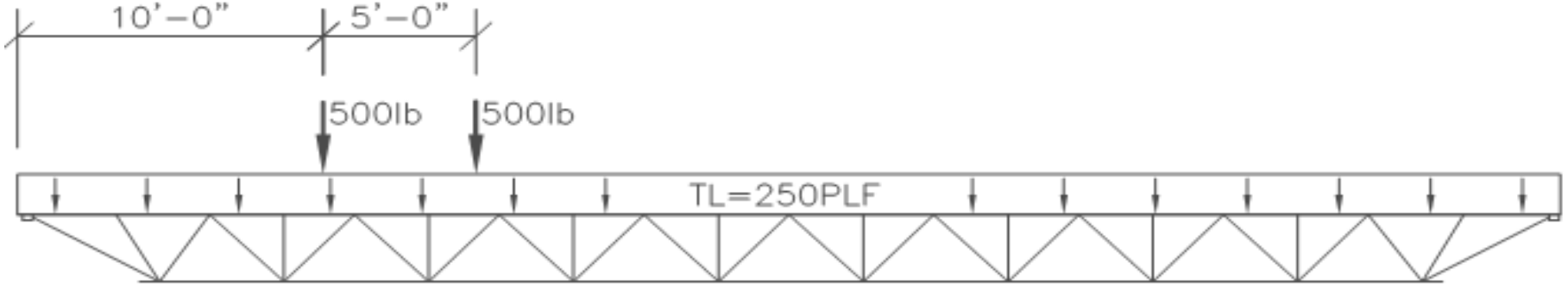


ORIGINAL DESIGN LOADS



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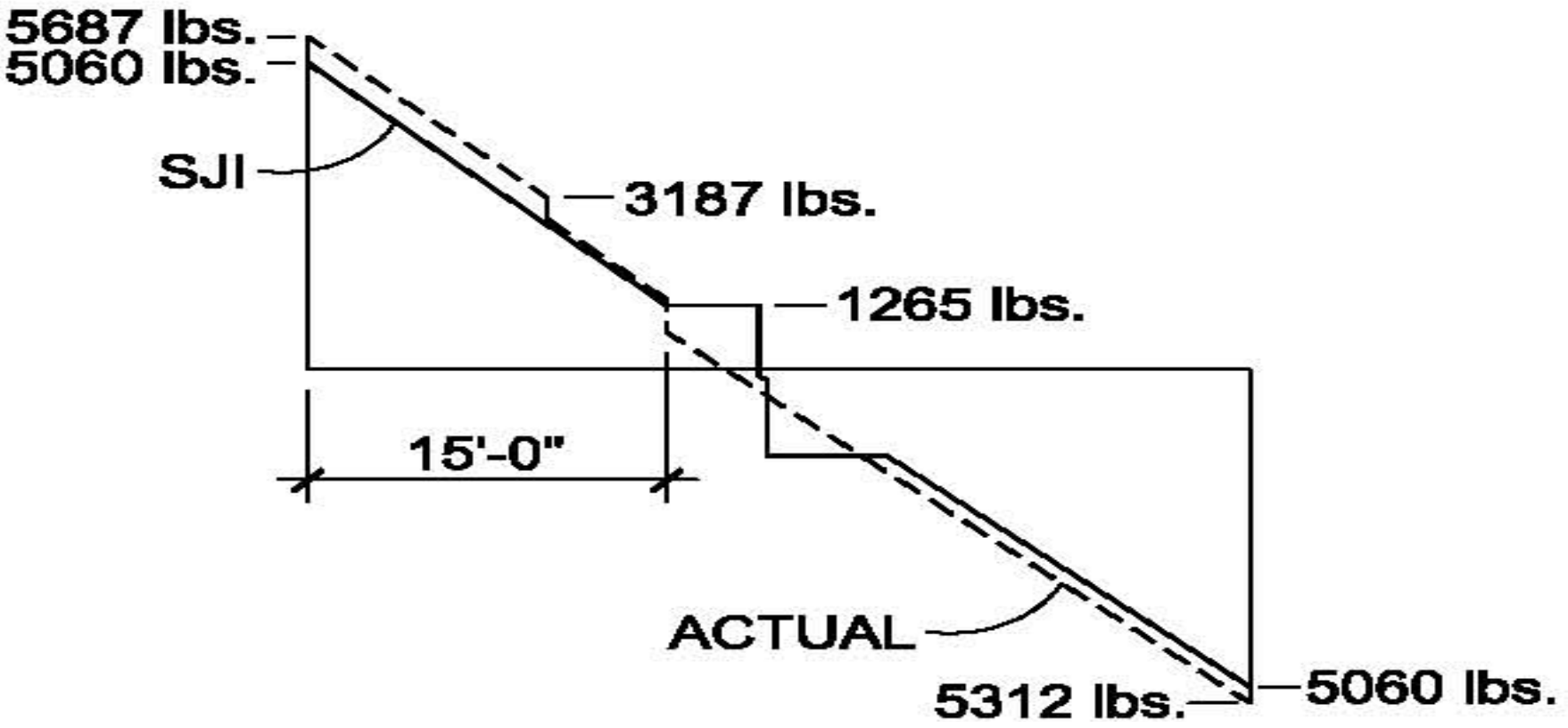
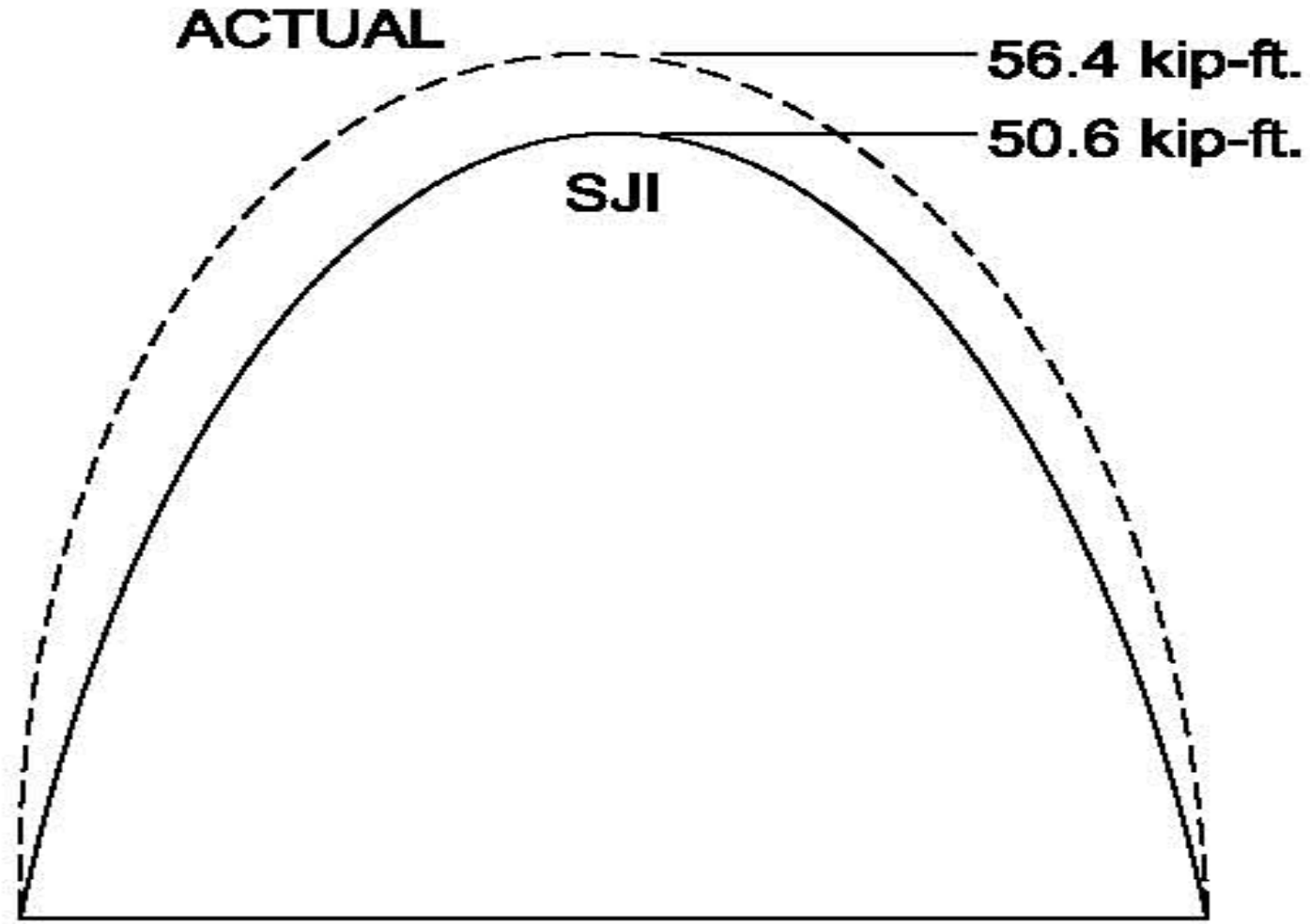
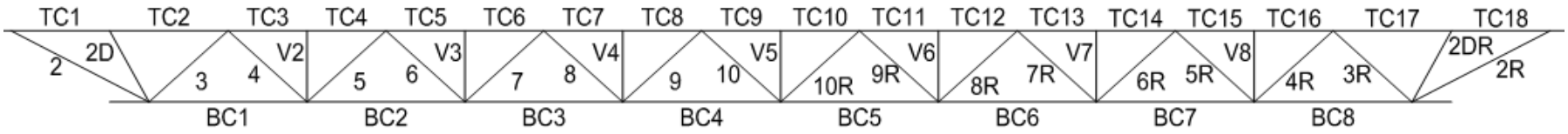


Example 1.1
Moment Diagram for 24K7 Joist



Joist Diagram



Existing Top Chord Review

- TC are continuous and segments 7 thru 12 have a larger axial force than the maximum in a 24K7.

- Forces shown are compression.

TC Segment Number	24K7 Axial Design Force	Revised Loading Required Axial Force
1	9937	11319
2	9477	10861
3	16924	19704
4	16924	19704
5	22207	25863
6	22207	25863
7	25374	29194
8	25374	29194
9	26429	29548
10	26429	29548
11	25374	27841
12	25374	27841
13	22207	24038
14	22207	24038
15	16924	18132
16	16924	18132
17	9477	10075
18	9937	10532

Existing Bottom Chord Review

- BC are continuous and segments 3 thru 6 have a larger axial force than the maximum in a 24K7.

- Forces shown are tension.

BC Segment Number	24K7 Design Axial Force	Revised Loading Required Axial Force
1	13525	15606
2	19834	23322
3	24054	27948
4	26165	29600
5	26165	28955
6	24054	26202
7	19834	21352
8	13525	14426

Existing Web Review

- All the webs have higher axial loads.
- Note the 25% minimum axial force.
- Design software can change the values.

+ tension
- compression

Web Number	24K7 Axial Force	Revised Loading Axial Force
2	+ 11021	+ 12539
2D	- 1128	- 1133
3	- 5608	- 6555
4	+ 4709	+ 5662
V2	- 600	- 606
5	- 4033	- 4998
6	+ 3287	+ 3510
V3	- 635	- 581
7	- 2560	- 2882
8	+ 1828	+ 2061
V4	- 638	- 948
9	-1828	-2061
10	+ 1828	-2061
V5	- 635	- 665
10R	+ 1828	+ 2061
9R	-1828	-2061
V6	- 638	- 649
8R	+ 1828	+ 2265
7R	- 2560	- 2990
V7	- 635	- 645
6R	+ 3287	+ 3711
5R	- 4033	- 4450
V8	- 600	- 610
4R	+ 4709	+ 5120
3R	- 5608	- 6011
2DR	- 1128	- 1135
2R	+ 11021	+ 11668

Example 1.1a

Original loads

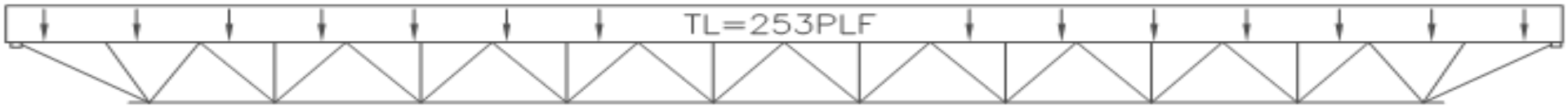
- Assume 20 psf DL
- Assume 30 psf LL
- Assume 5’ joist spacing
- Total uniform load 250 plf

Revised loads

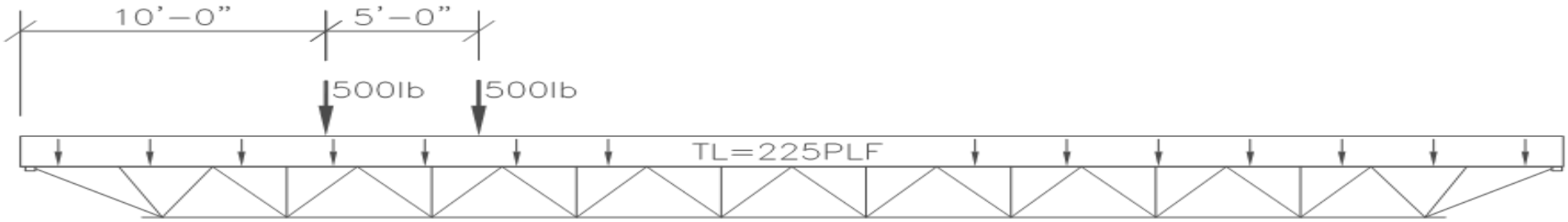
- **Assume 15 psf DL**
- **Assume 30 psf LL**
- **Assume 5’ joist spacing**
- **Total uniform load 225 plf**

Example 1.1a

Load diagram



ORIGINAL DESIGN LOADS



ACTUAL LOADS

Example 1.1a

Top chord review

- TC are continuous and fewer segments have ratios over 1

- Forces shown are in compression.

TC Segment Number	24K7 Design Axial Force	Revised Loading Required Axial Force
1	9937	10327
2	9477	9916
3	16924	18015
4	16924	18015
5	22207	23646
6	22207	23646
7	25374	26661
8	25374	26661
9	26429	26911
10	26429	26911
11	25374	25309
12	25374	25309
13	22207	21822
14	22207	21822
15	16924	16443
16	16924	16443
17	9477	9129
18	9937	9541

Example 1.1a

Bottom chord review

- BC are continuous and segments 4 thru 5 have a larger axial force than the maximum in a 24K7.
- About a 3% greater force.
- Forces shown are in compression.

BC Segment Number	24K7 Design Axial Force	Revised Loading Required Axial Force
1	13525	14256
2	19834	21342
3	24054	25547
4	26165	26989
5	26165	26344
6	24054	23802
7	19834	19373
8	13525	13076

Example 1.1a

Web review

- Many webs have higher axial loads.
- Note the 25% minimum axial force.
- Actual capacities need to be reviewed verses required forces.
- Actual weld length need to be verified.

+ tension

- compression

Web Number	24K7 Design Axial Force	Revised Loading Required Axial Force
2	+ 11021	+ 11441
2D	- 1128	-1021
3	- 5608	-5998
4	+ 4709	+ 5194
V2	- 600	-546
5	- 4033	-4598
6	+ 3287	+ 3184
V3	- 635	-518
7	- 2560	-2627
8	+ 1828	+1879
V4	- 638	-885
9	-1828	-1879
10	+ 1828	-1879
V5	- 635	-602
10R	+ 1828	+ 1879
9R	-1828	-1879
V6	- 638	-586
8R	+ 1828	+ 2083
7R	- 2560	-2736
V7	- 635	-582
6R	+ 3287	+ 3384
5R	- 4033	-4049
V8	- 600	-551
4R	+ 4709	+ 4652
3R	- 5608	-5454
2DR	- 1128	-1021
2R	+ 11021	+ 10570

Example 1.1b

- An alternate approach would be to check the manufactured joist using the actual design dead and live loads in lieu of the load capacity from the SJI tables.
- From a review of the structural drawings the joist spacing is found to be 4’-10” o.c. and the roof slope is ½:12.
- A check of the roof materials found that the actual roof dead load, including an allowance for the joist weight, is 15 psf.

Methods of Supporting Additional Load

Options Before Strengthening

- Capacity of joist needs to be determined
  - Can joist safely support new loads?
  - What are the actual loads?
  - What are the actual load cases?
  - Are stress ratios over 1.0 permitted?

Methods of Supporting Additional Load

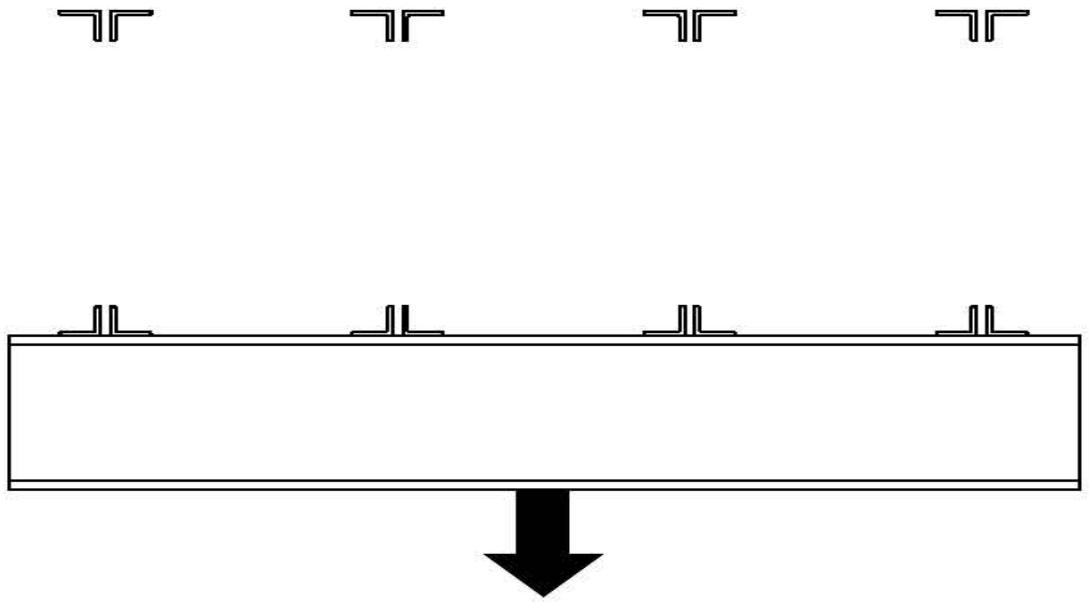
Options Before Strengthening

- Extensive reinforcement may not be practical
  - Option #1 - Load distribution
  - Option #2 - Add new joists or beams
  - Option #3 - Reinforce existing joists

Load Distribution

Member with suitable stiffness required

- Place member under or through the joists
- Concentrated load distributed to several joists



Design Approaches for Strengthening Joists

Two design approaches to reinforce individual joist members

- Approach I
  - Ignore the existing member strength
  - Simply design the reinforcing members to carry the total load
- Approach II
  - Make use of the strength of the existing member

Design Approaches for Strengthening Individual Joist Members

Considerations for either approach

- Cost of materials for reinforcement is insignificant to the cost of labor
- Safest to reinforce the joist in the shored position
  - Welding can generate enough heat to cause temporary loss of steel strength
  - Transverse field welds should be avoided
- Best to reinforce the members with dead and live loads removed
  - Jack the joist up to a calculated deflection
- Pay close attention to eccentricities caused by the reinforcing

Design Approaches for Strengthening Individual Joist Members

For Approach II

- It is assumed that applied forces are distributed between the existing member and the reinforcing member
  - Direct proportion to their areas
- If joists are shored to remove existing load
  - The preload is then zero
- If joists are not shored
  - Preload can be calculated based on load present at the time of reinforcing
- Shoring and jack placement is the responsibility of the specifying professional

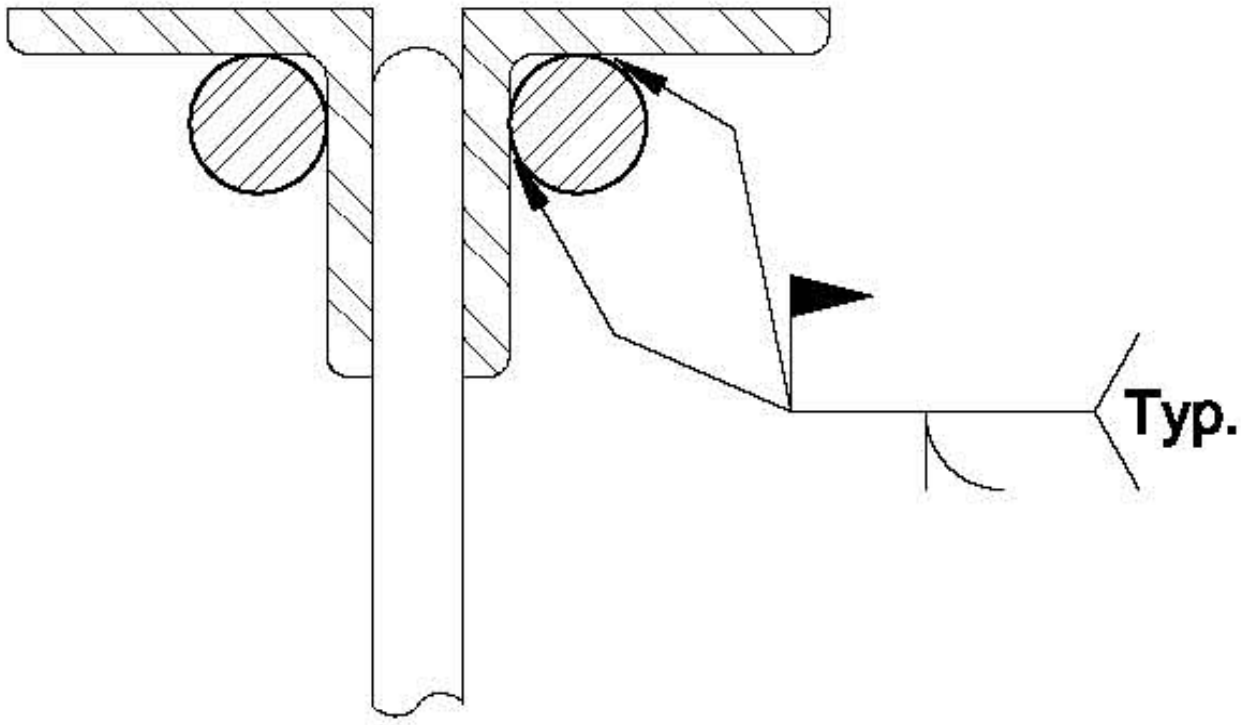
Chord Reinforcement

Typical reinforcement details

- Top chord
  - More difficult to reinforce since the floor or roof deck is usually in place
  - Overhead welds may be required
- Bottom chord
  - Easier to access
  - No overhead welds required

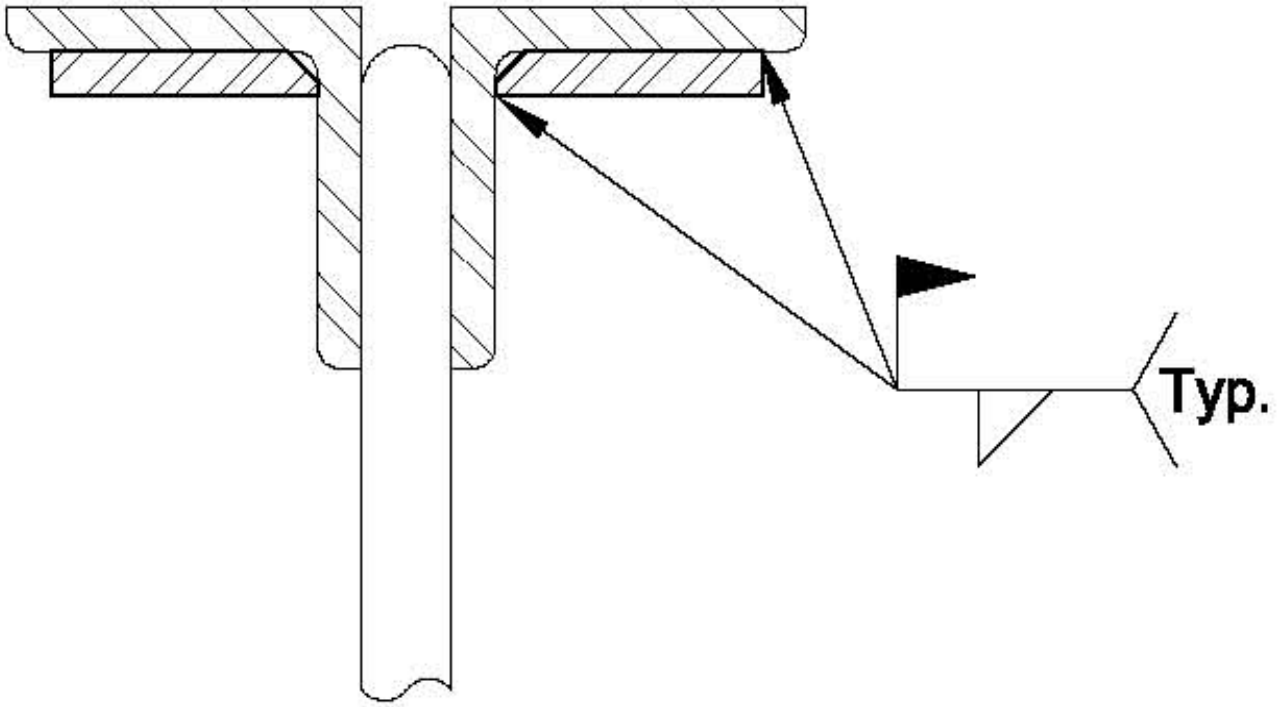
Chord Reinforcement

Top chord reinforcement – rods



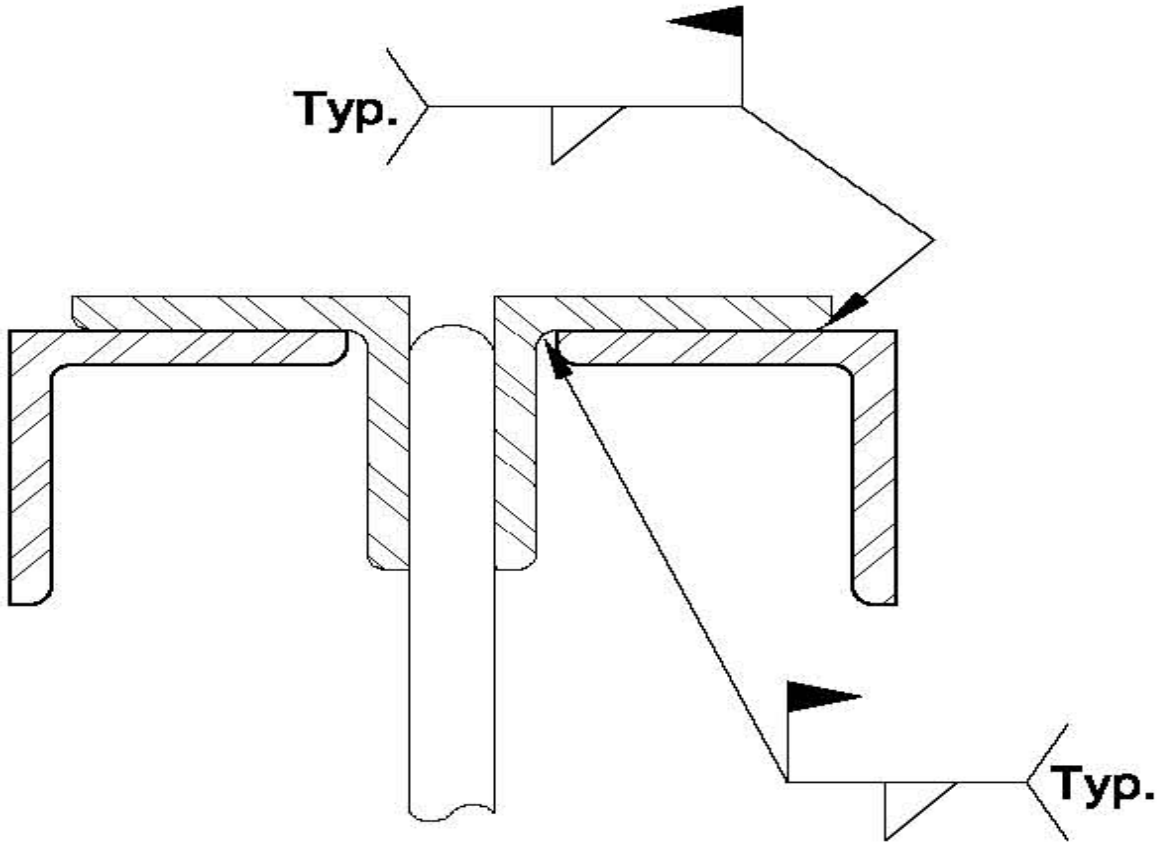
Chord Reinforcement

Top chord reinforcement – plates



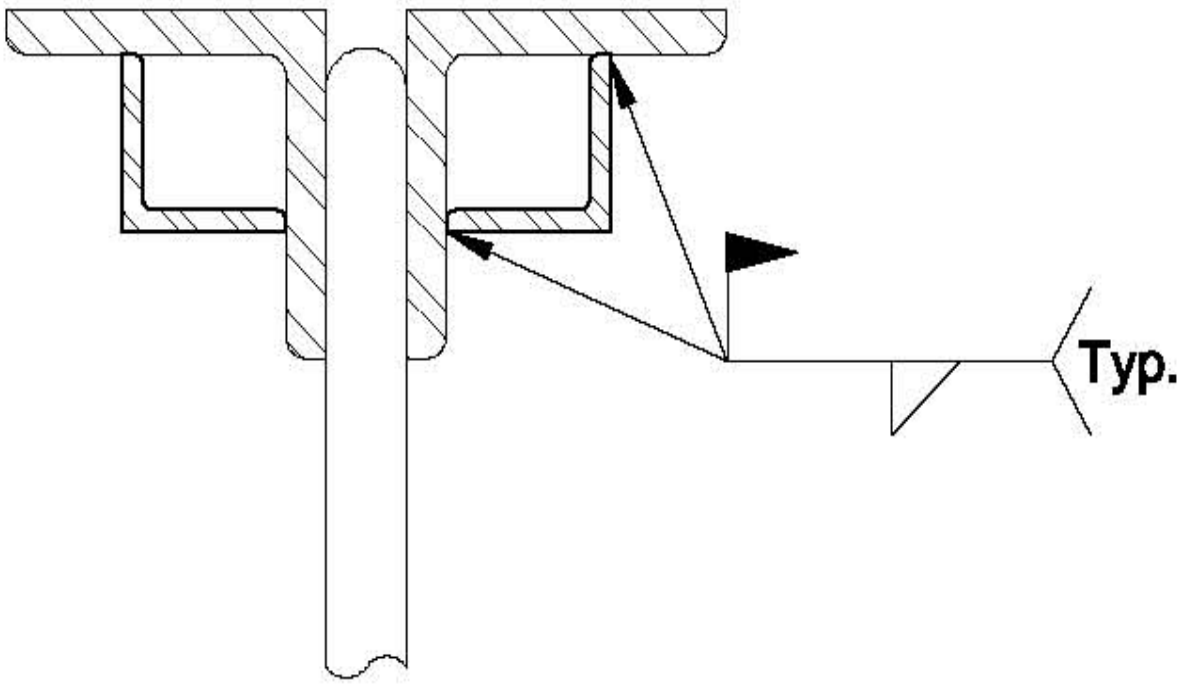
Chord Reinforcement

Top chord reinforcement – angles



Chord Reinforcement

Top chord reinforcement – angles

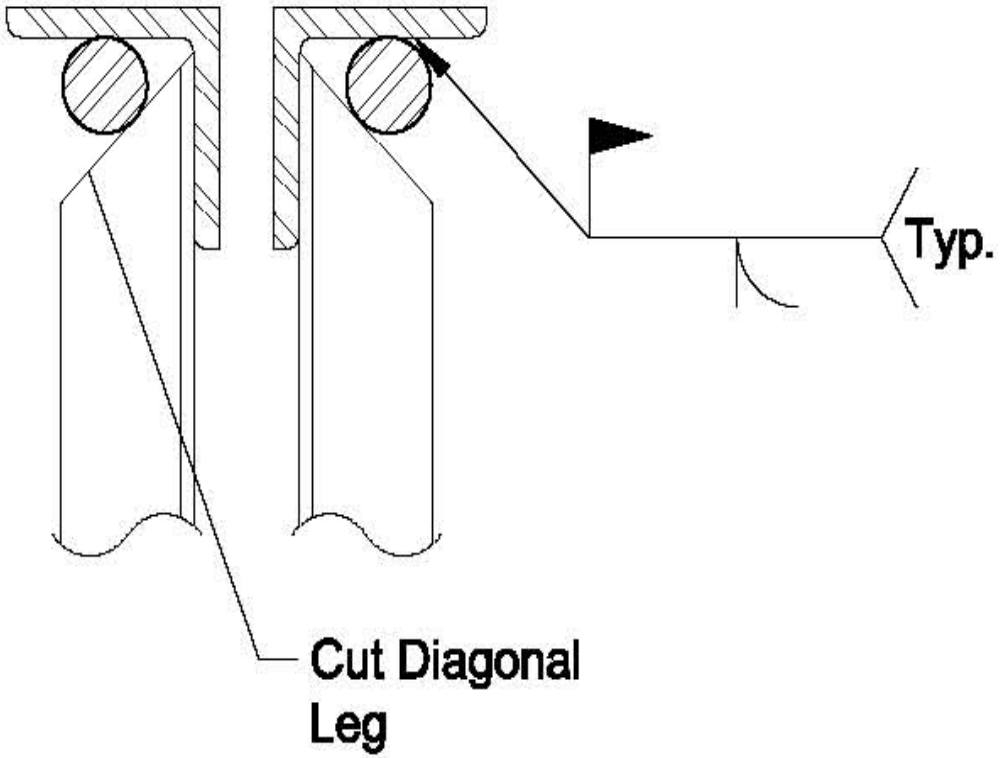


Chord Reinforcement

Angle interference with top chord reinforcement

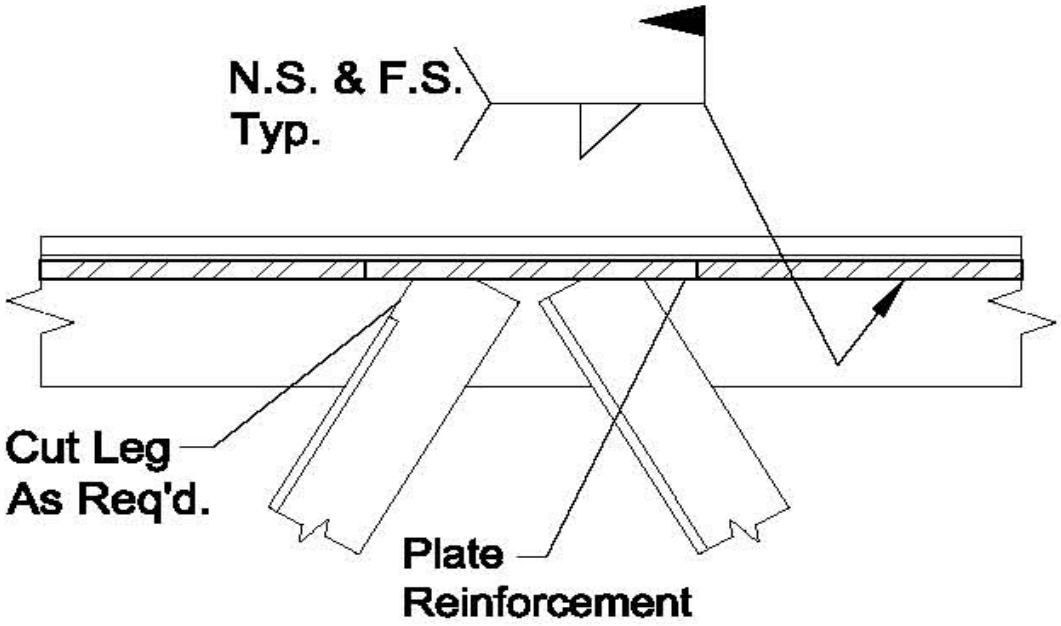
Chord Reinforcement

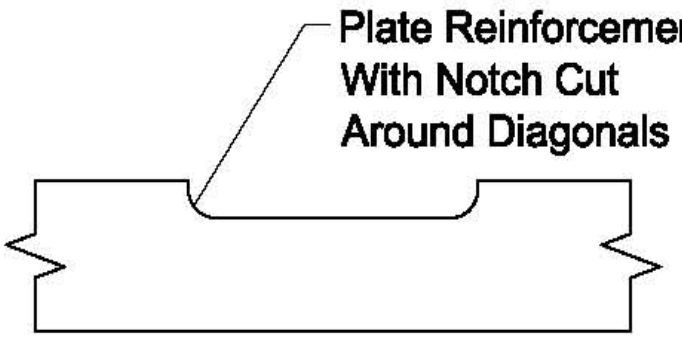
Top chord reinforcement – rods



Chord Reinforcement

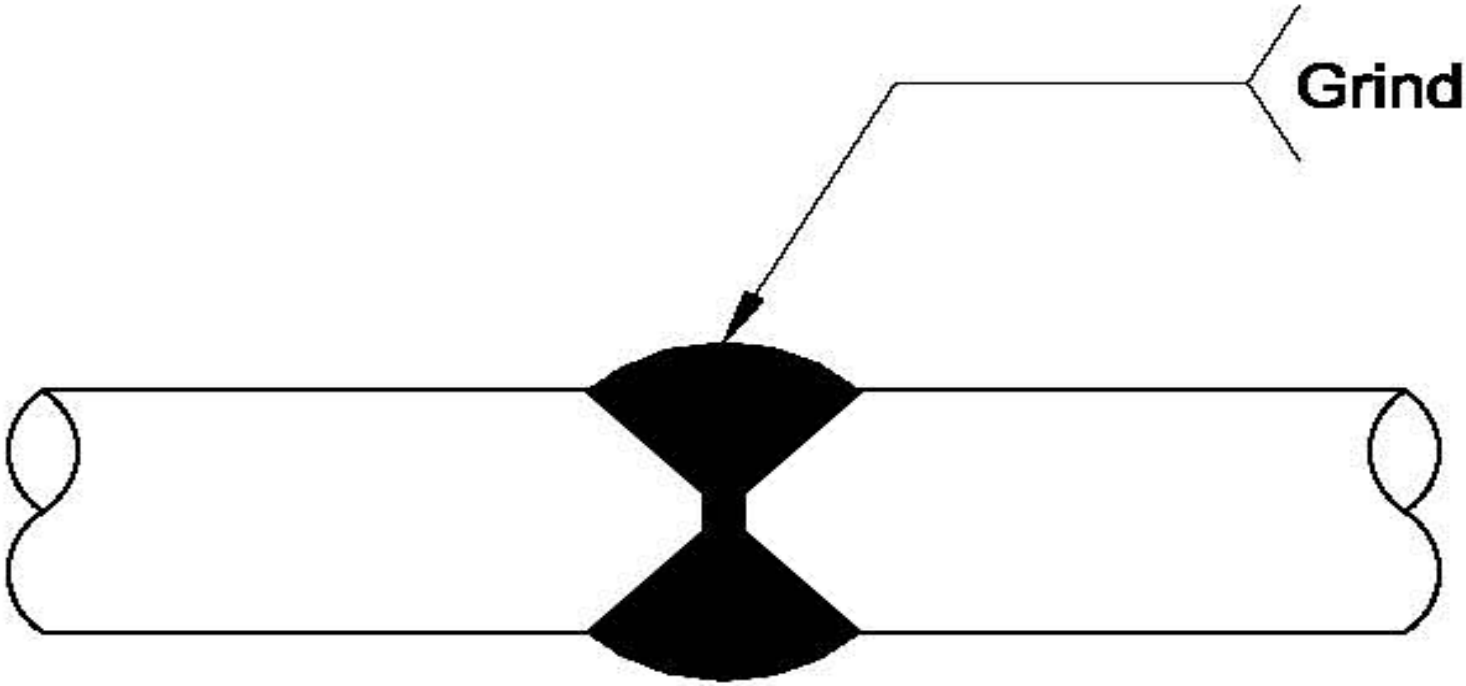
Top chord reinforcement requiring notch





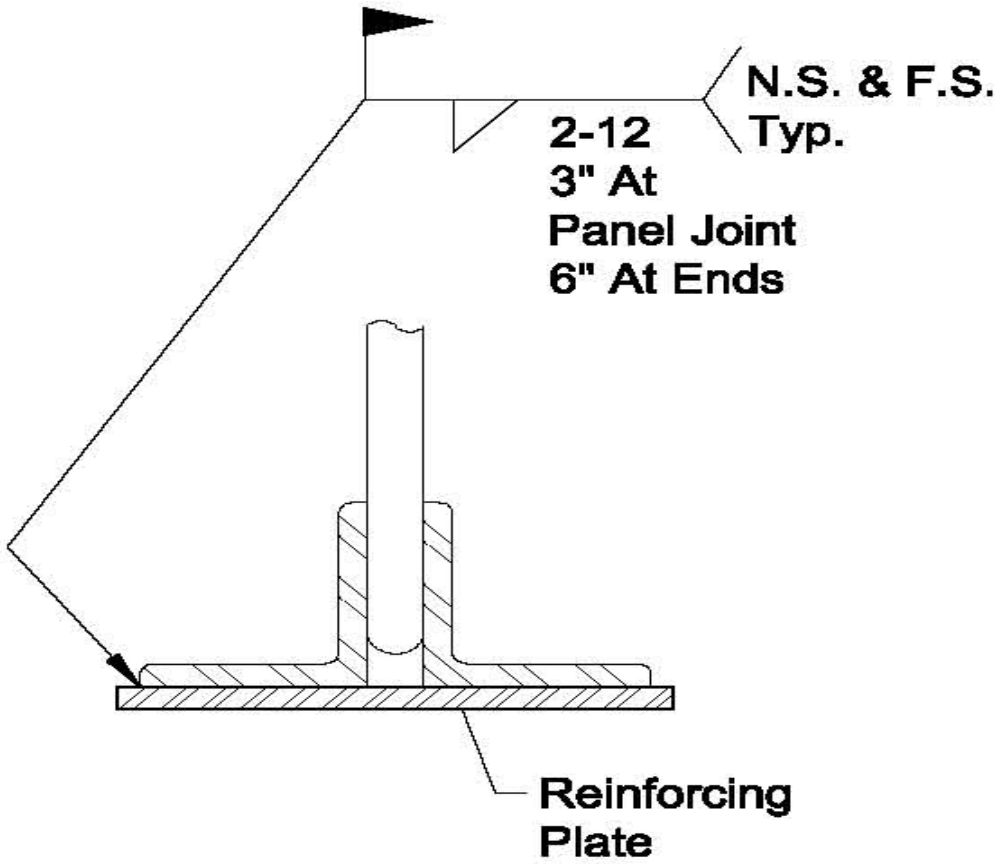
Chord Reinforcement

Rod splice

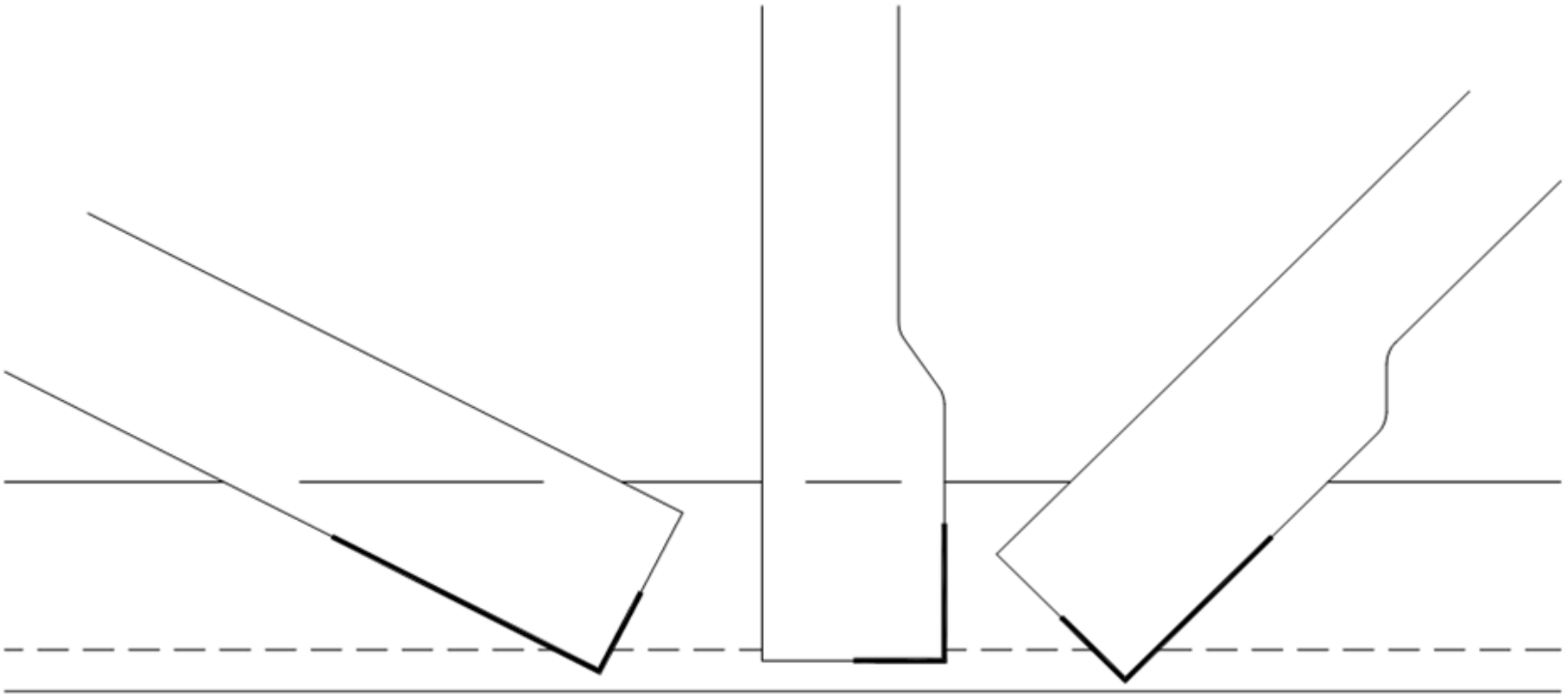


Chord Reinforcement

Bottom chord reinforcement

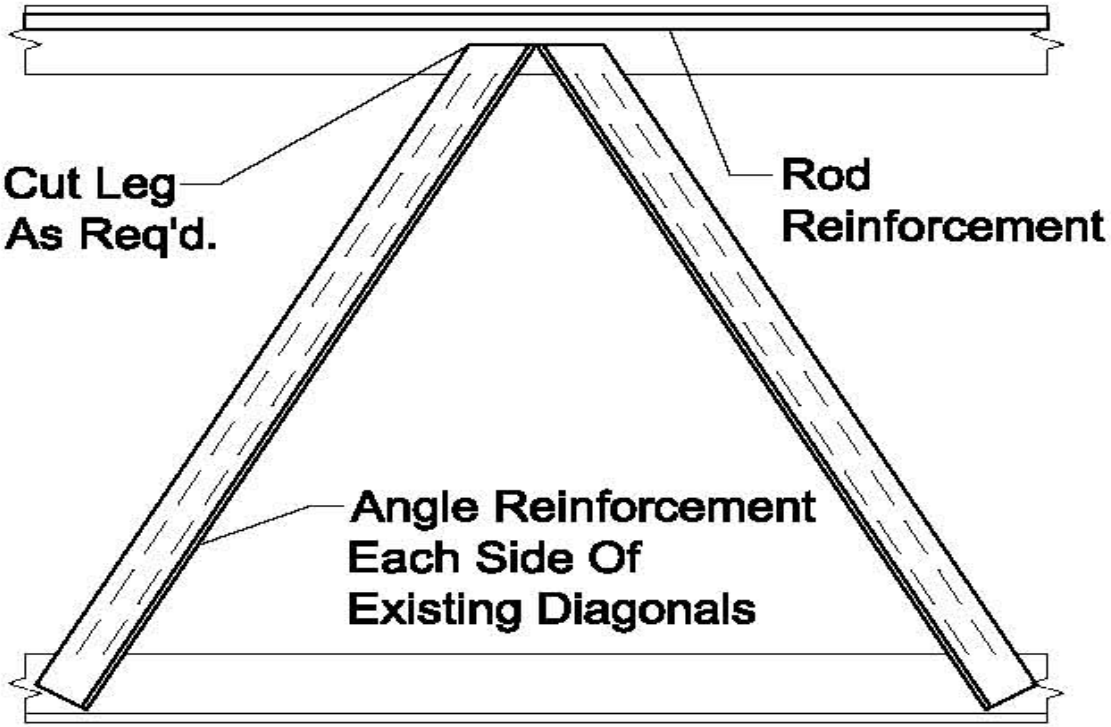


Web Weld Location for Crimped Angles and Solid Rounds or Square Bars



Rod Web Reinforcement

Angle reinforcement on rod web joist



Rod Web Reinforcement

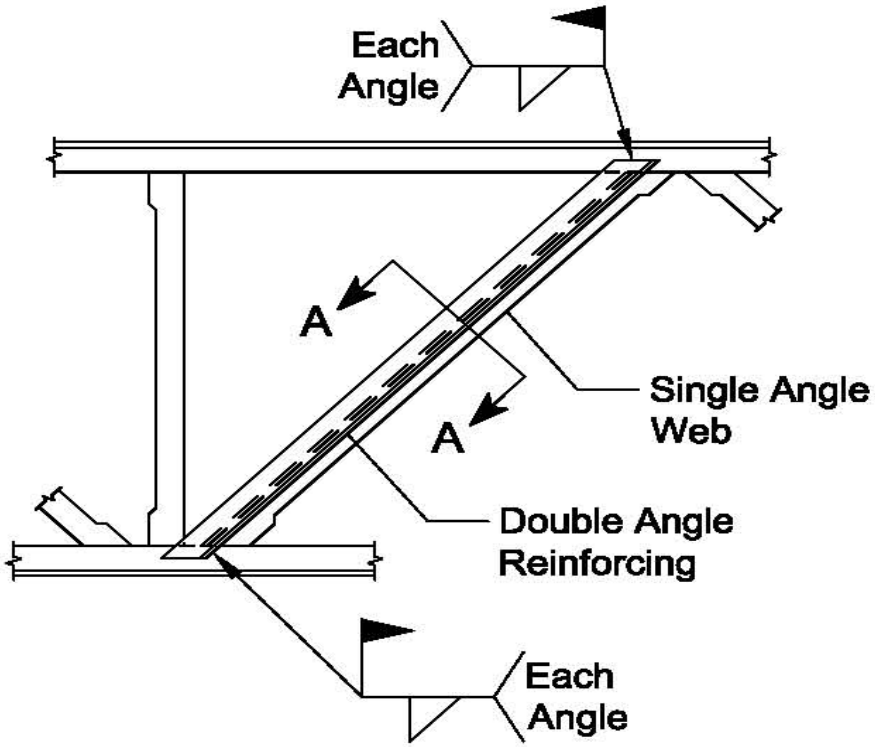
Angle reinforcement on rod web joist

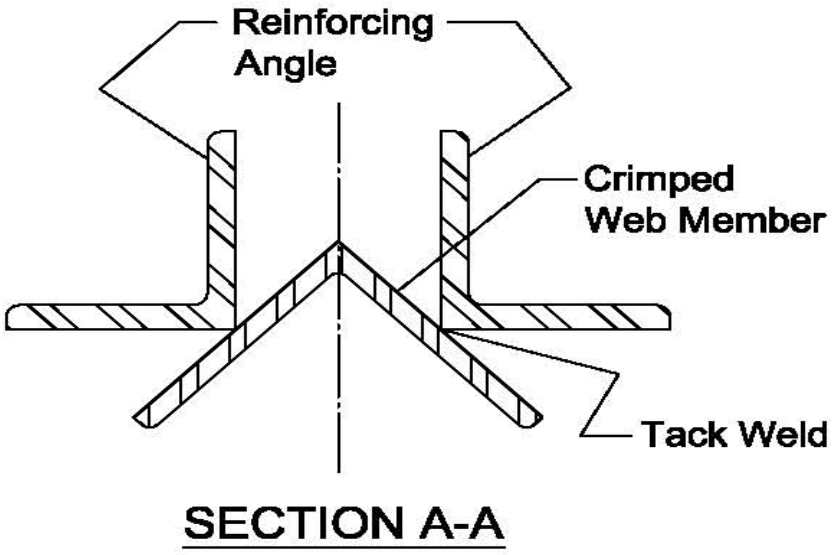
Crimped Web Reinforcement

Joist with crimped web members

Crimped Web Reinforcement

Angle reinforcement on crimped web joist

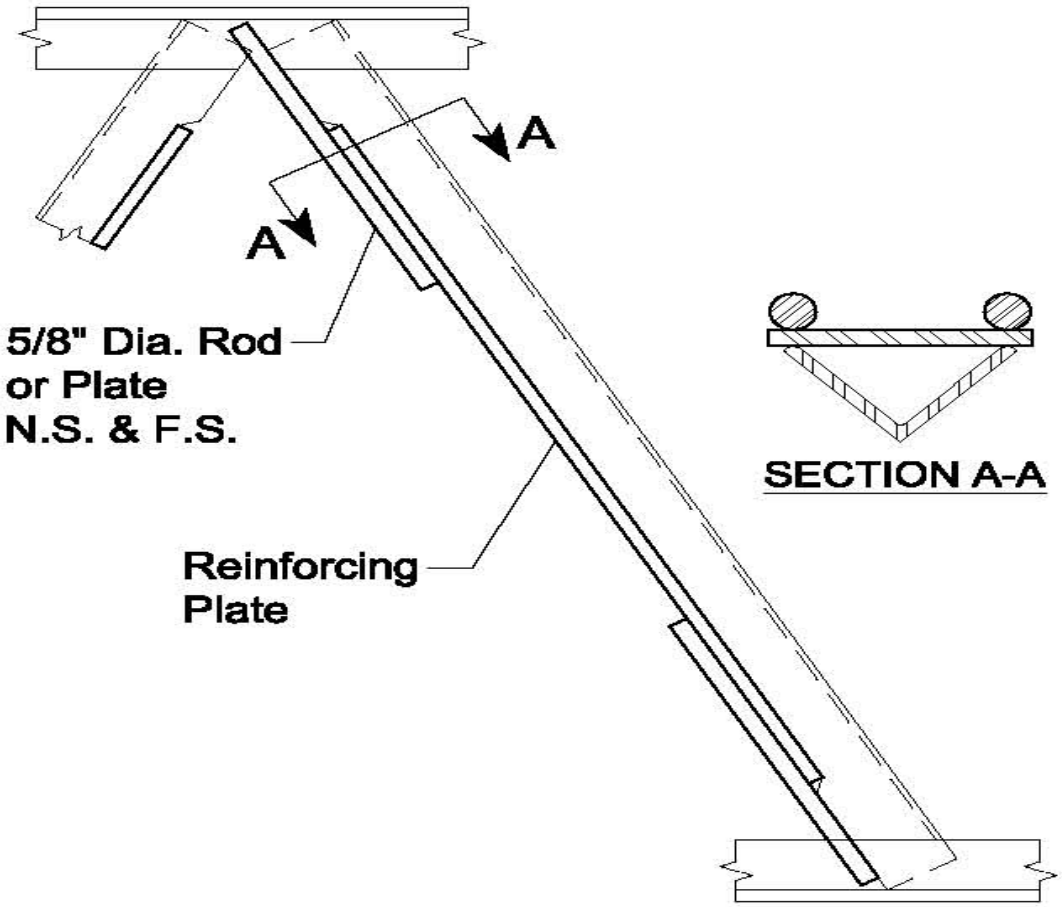




Crimped Web Reinforcement

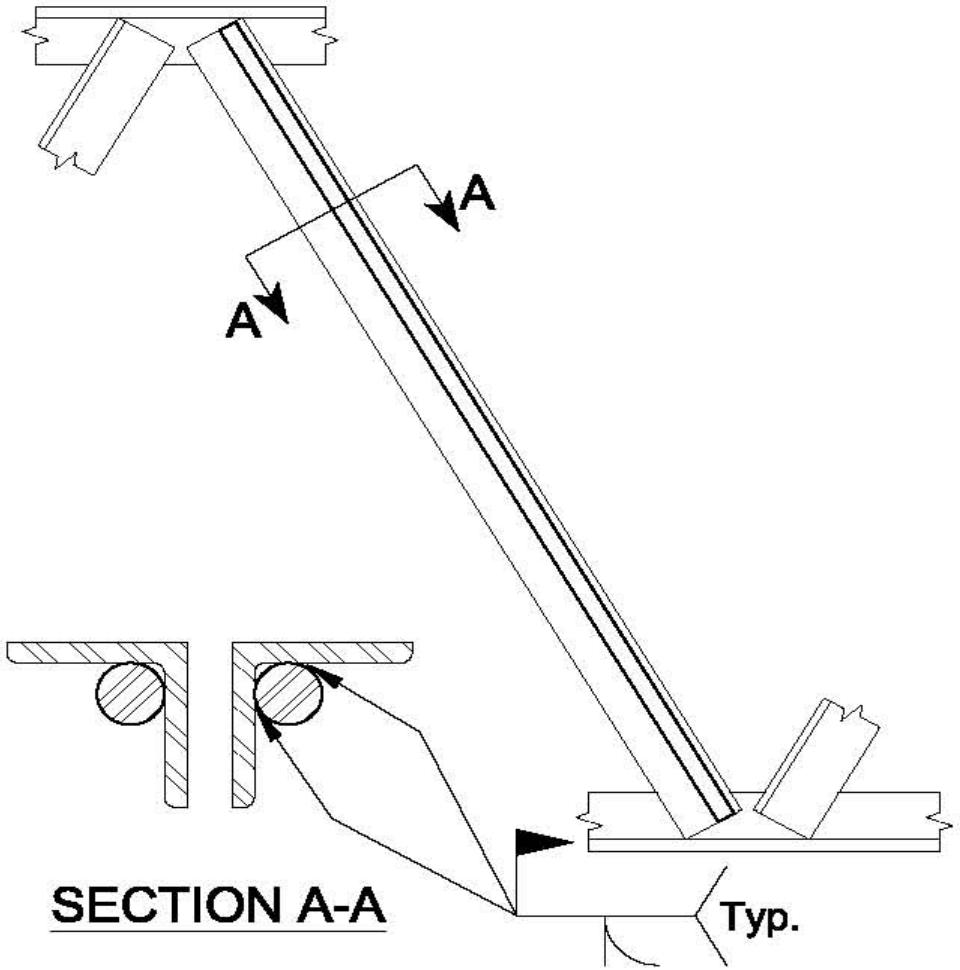
Angle reinforcement on crimped web joist

Crimped Web Reinforcement



Double Angle Web Reinforcement

Angle web reinforcement with rod

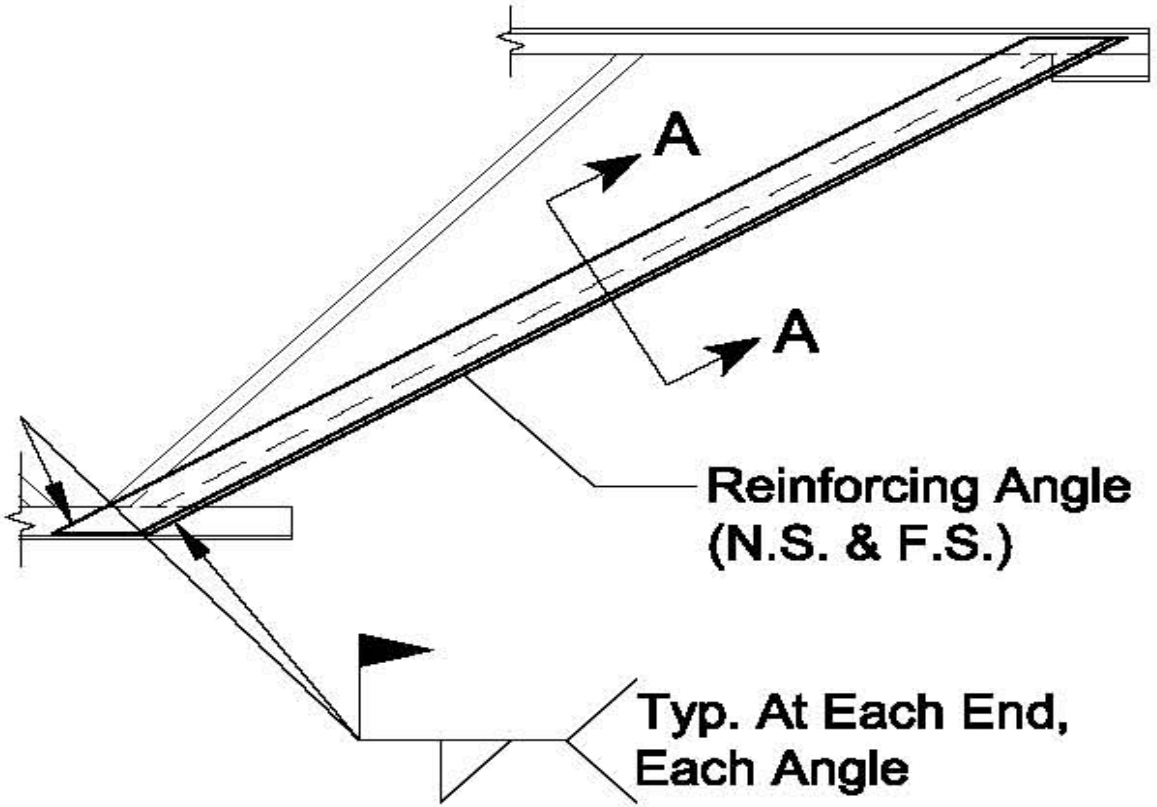


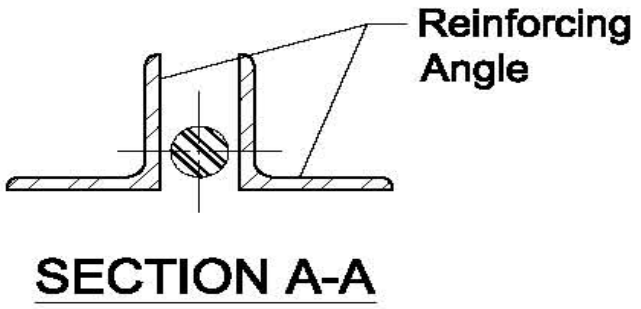
Double Angle Web Reinforcement

Angle web reinforcement with rod

End Diagonal Web Reinforcement

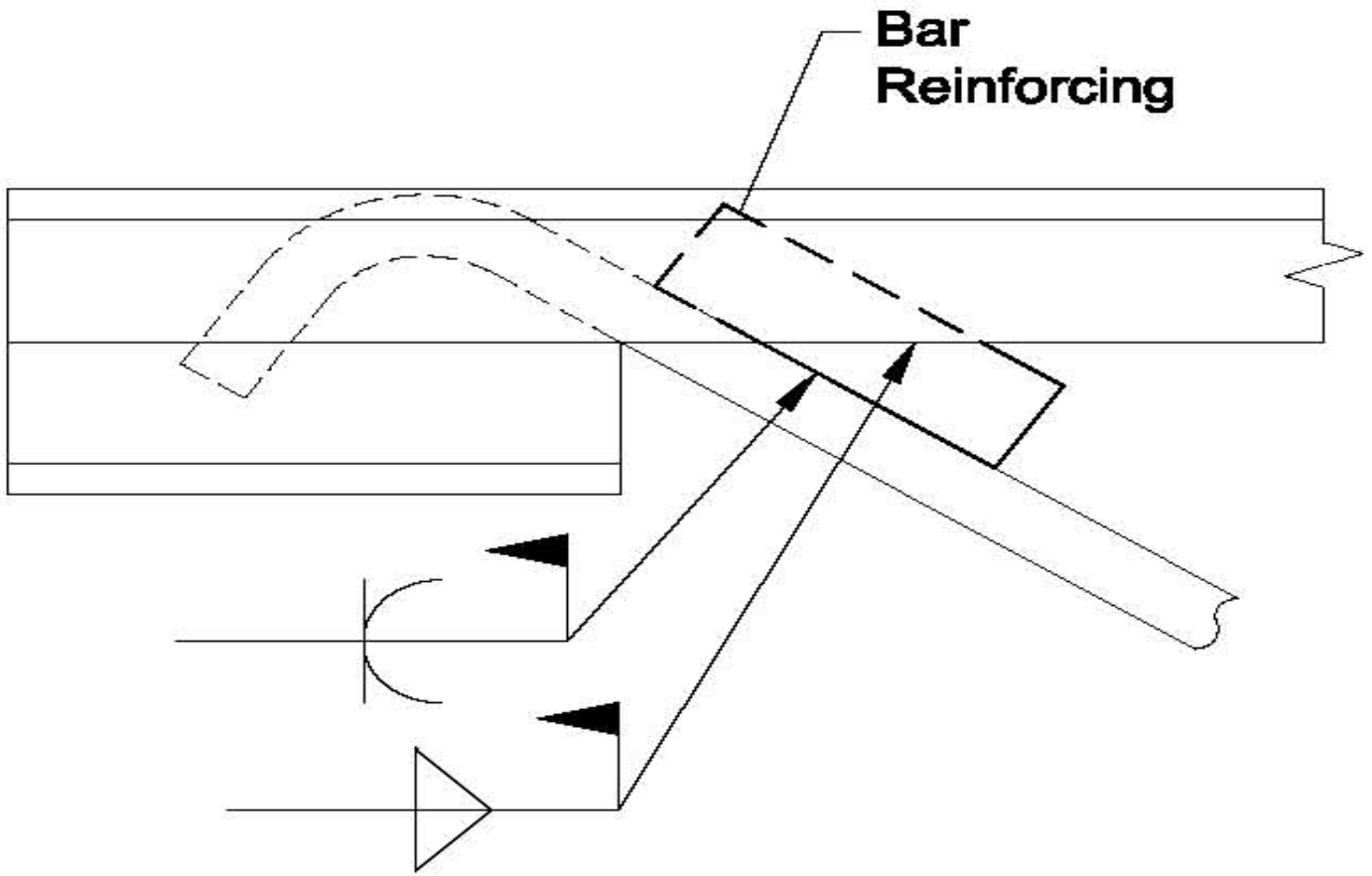
End diagonal reinforcement with angle





End Diagonal Web Reinforcement

Bar added for additional weld on end diagonal



Reinforcing vs Replacing vs Adding

Considerations

- Cost – Field labor costs lots of money
- Time – Time is money
- Difficulty of repair – Interferences, Access
- Effectiveness of reinforcing
- Skill of workman

Reinforcing vs Replacing vs Adding

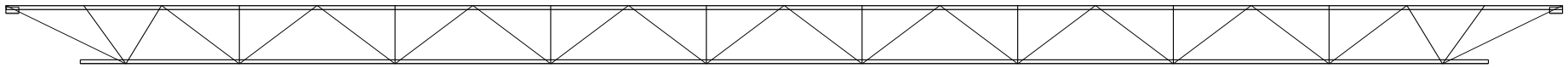
Considerations

- Existing interferences
  - Piping, electrical conduits, other interferences
  - Removing or relocating could be at a greater expense than reinforcement
- Camber
  - May need to reduce camber in new joists
  - Joists can be ordered with shallower seat depths and then shimmed in the field
  - The joist can be supplied with a splice so two individual pieces can be installed and bolted at the center

Reinforcing vs Replacing vs Adding

Camber – Joists manufacturers rigging tables are set up for SJI standard camber. If replacing or adding a joist, specify zero or no camber.

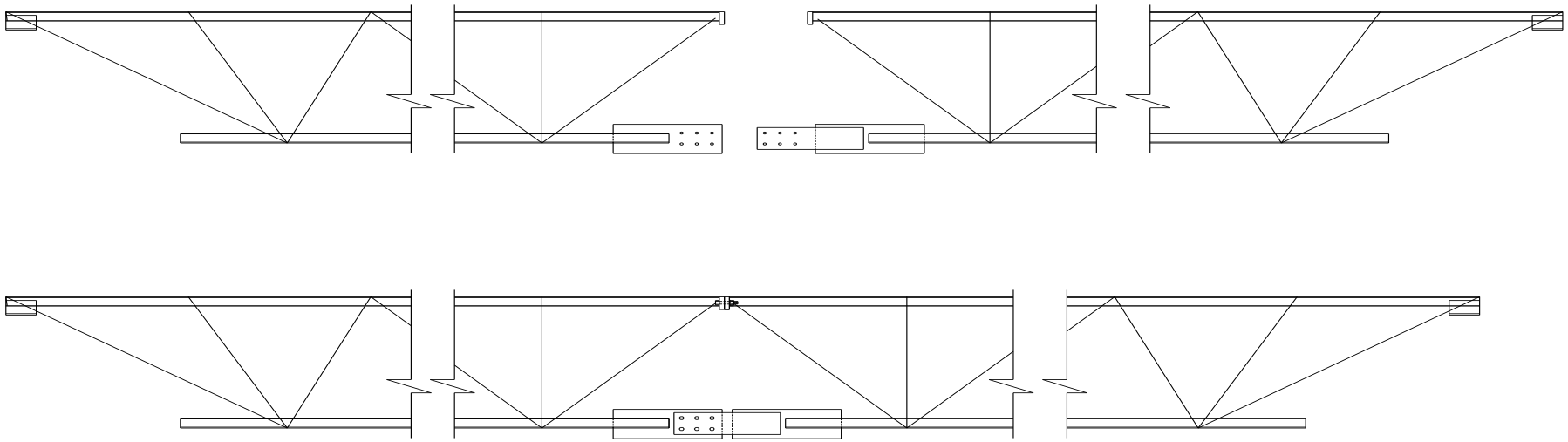
MANUF'D JOIST W/ STD. CAMBER
PRIOR TO INSTALLATION



JOIST AFTER INSTALLATION
WITH DEAD LOADS APPLIED

Reinforcing vs Replacing vs Adding

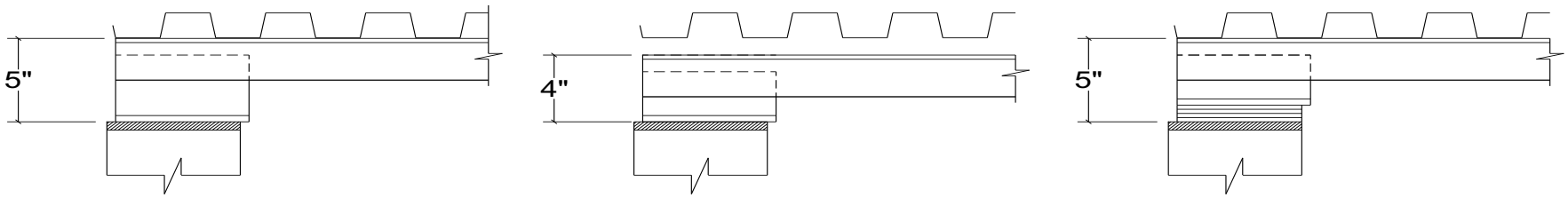
Splice – When adding a joist into an existing building, a field bolted splice allows each half of the joist set in place and then mated together.



JOIST w/ BOLTED SPLICE

Reinforcing vs Replacing vs Adding

Bearing seat depth – Specify a shallower seat depth and then shim to raise top chord to deck.



INSTALLED BEARING SEAT FOR EXISTING JOIST

NEW JOIST W/ SHALLOWER BEARING SEAT PRIOR

NEW JOIST W/ SHALLOWER BEARING SEAT AND SHIMMS

Reinforcing vs Replacing vs Adding

Considerations

- Lateral stability of the joist top chord
  - Shoot pins through the chord, decking, and slab
  - Rely on bridging to provide lateral support

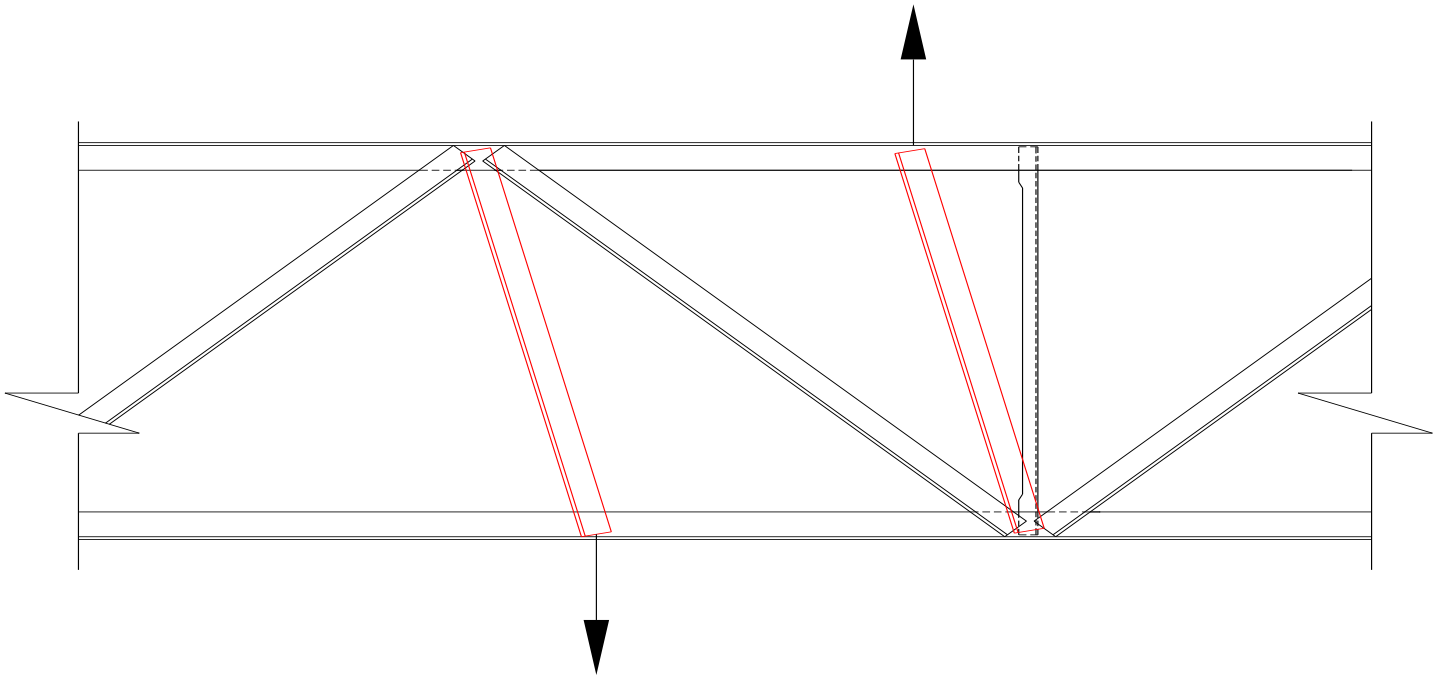
Reinforcing Existing Joists

The following will impact reinforcement of both chord and web members:

- Rod web joists
  - New reinforcing webs can be easily added on the outside of the chords.
  - Chords are typically thin angles.
- Crimped angle web joists
  - New reinforcing webs can be easily added on the outside of the chords.
  - If chords and webs need to be reinforced there could be interferences which affect how the reinforcement is done.

Reinforcing Existing Joists

For larger LH-Series and Joist Girders - Double angle diagonal webs may intersect at a bottom chord panel point there will not be room to add and weld a reinforcing web at that panel point to pick up a load. The chord will have to be checked for local bending.



Reinforcing Existing Joists

The following will impact reinforcement of both chord and web members:

- Chord and web yield strength
  - Recent manufacturing (15 – 20 years) has used 50 ksi steel for chord and webs.
  - Older joists may have been manufactured using 36 ksi steel and test coupons may be required to determine the Yield Strength of the joist members.

Other Considerations

Deflections

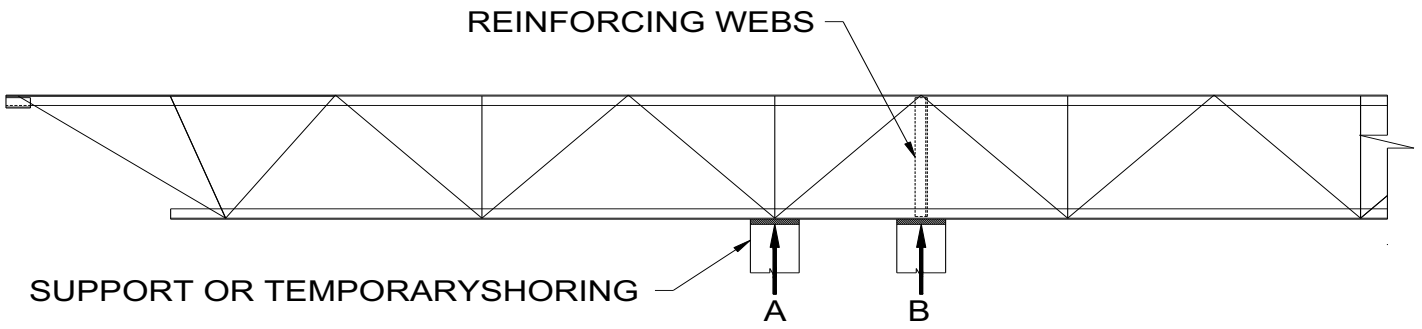
- Deflection control is often required in addition to strengthening joists for load
- Project deflection requirements must be considered
  - A live load deflection less than L/240 may not be met if a joist is only strengthened for added loads from a snow drift.

Other Considerations

- When shortening or lengthening a joist, camber needs to be maintained whenever removing any web members
- Bridging Effects for Additional Loads
  - Bridging may need to be added or modified
    - Providing the required lateral support to compression chord members is critical.
    - Bottom chord may be subjected to compression during uplift loads.
  - Refer to the SJI Specifications for bridging requirements.

Other Considerations

- Additional supports can be added to a joist to increase capacity. This will drastically alter the web shears and may cause load reversal in webs.
- If the support is added between bottom chord panel points, Support Pt. B, reinforcing webs must be added to support the bottom chord.



Polling Question

When doing a joist repair what is generally the most expensive?

A. Material

B. Labor

Questions?

THANK YOU

Presented by:

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